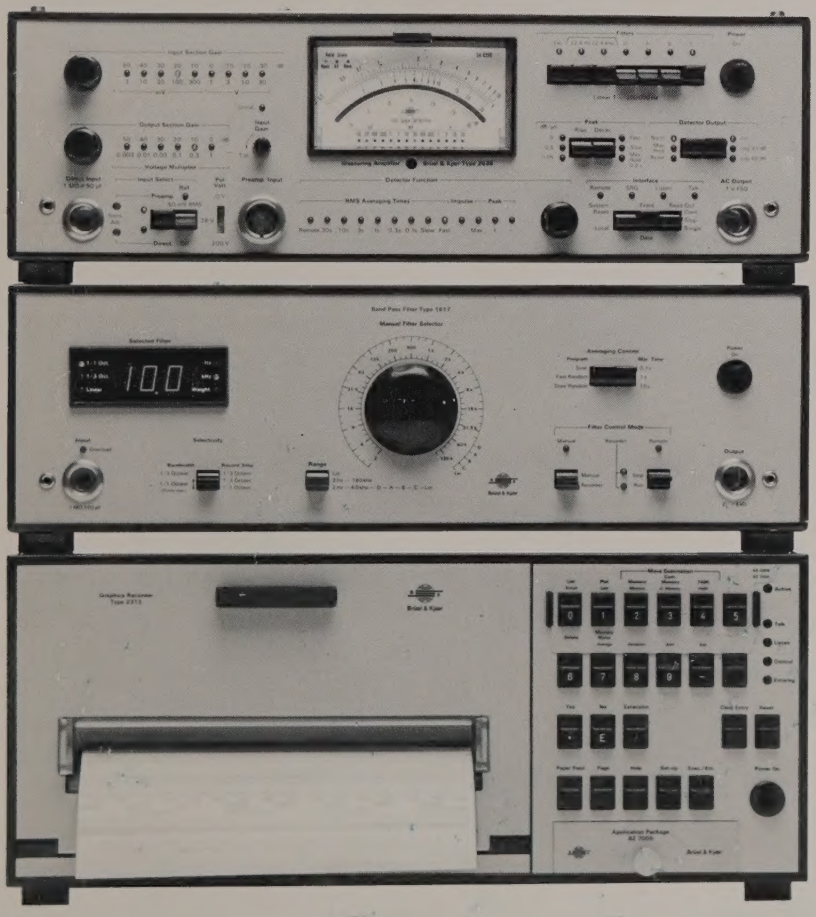
2313
BZ 7005

Instruction Manual

Graphics Recorder Type 2313
plus Application Package BZ 7005



A versatile system controller and documentation unit, accepting a choice of plug-in Application Packages for use with B&K analysis equipment featuring an IEC/ IEEE digital interface. With an Application Package BZ 7005 fitted it may be used to list and plot 1/1 and 1/3 octave spectra measured with a B&K Band Pass Filter Type 1617 and Measuring Amplifier Type 2636. In addition, it performs a wide variety of special tasks, which simplify analysis of signals and enable new types of measurement to be made. For example, it can automatically step the gain and averaging time of the 2636 to suit measured signal – Store up to 300 sets of spectra plus a 250 step pushkey control sequence – Add, subtract and average spectra, plus record time histories and determine L_{eq} etc.

Brüel & Kjær

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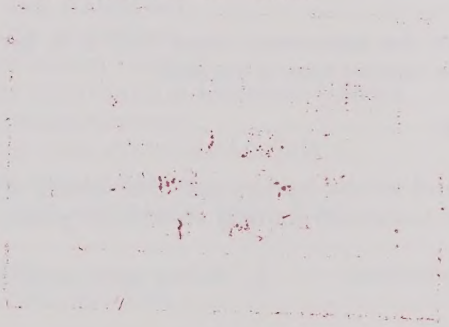
GRAPHICS RECORDER TYPE 2313
PLUS
APPLICATION PACKAGE BZ 7005

From serial number 973241



February 1985

SAFETY CONSIDERATIONS

This apparatus has been designed and tested according to Class II of IEC Publication 348, Safety Requirements for Electronic Measuring Apparatus, and has been supplied in safe condition. The present Instruction Manual contains information and warnings which should be followed by the user to ensure safe operation and to retain the apparatus in safe condition. Special note should be made of the following:

APPLICATION OF POWER

Before each use of the apparatus, check that it is set to match the available mains voltage and that the correct fuse is installed.

SAFETY SYMBOLS

⚠ The apparatus will be marked with this symbol when it is important that the user refer to the associated warning statements given in the Instruction Manual.

⊥ Chassis terminal ⏚ Safety earth terminal ⚡ Hazardous voltage

WARNINGS

Whenever it is likely that the correct function or operating safety of the apparatus has been impaired, the apparatus must be made inoperative and be secured against unintended operation.

Any adjustment, maintenance and repair of the open apparatus must be avoided as far as possible and, if unavoidable, must be carried out only by trained service personnel.

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Graphics Recorder

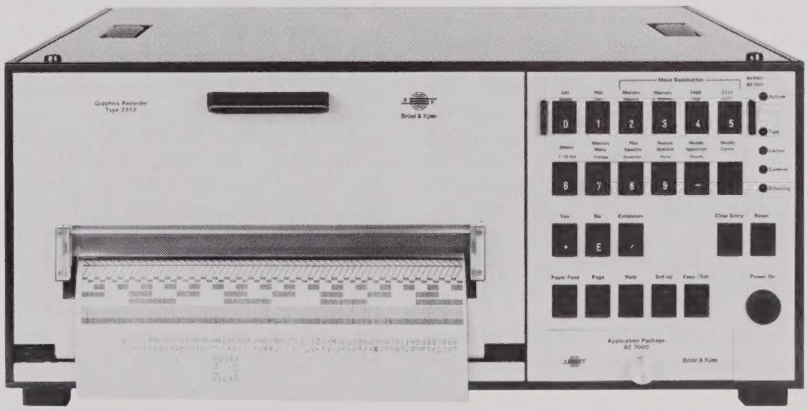
USES:

- Dot-matrix printer for plotting measured spectra presented on the display screen of B&K digital measuring or analyzing instrumentation, plus documenting front panel control settings etc.
- Versatile system controller for instruments equipped with IEC/IEEE digital interface bus
- Digital recorder for storage of spectra and front panel control setting data
- Reformatting of data for new types of measurement. Extends measurement capability of B&K equipment

FEATURES:

- High-resolution graphic and alphanumeric print out using fixed 512 point print head with 0,2 mm step paper feed
- Accepts 210 mm wide rolls of metallized paper. One 50 m roll equivalent to 160 A4 charts
- 96 standard and 32 special alphanumeric characters according to ISO 646 and 2022 standards
- Range of plug-in Application Packages available to suit the individual documentation and measurement needs of B&K measuring and analyzing equipment
- Built-in crystal controlled clock for print out of date and time together with measurement results
- Continuous and volatile memories for storage of measurement spectra
- Choice of Operating Set-Ups for specifying type of print out, memory allocation and measurement functions etc.
- Simple, easy to follow pushkey operation, plus extensive "Help" file for step by step guidance of first time users

Introduction



The Graphics Recorder Type 2313 is a highly versatile alphanumeric and graphics printer for use with B&K digital measuring and analyzing instrumentation equipped with an IEC interface bus. Together with an appropriate Application Package it offers fast, fully annotated, graphic plots of frequency spectra, time functions etc., as presented on the display screen of B&K instruments. In addition, it may be employed as a conventional alphanumeric/graphics printer for documenting data transmitted by other digital equipment furnished with an IEC or IEEE interface.

Besides documentation of data, the 2313 is capable of performing a variety of other important tasks for which extra equipment would normally be required. Using its continuous and volatile memories, for example, several hundred complete measurement spectra can be recorded and stored for future print out or transmission to other equipment. Also, new types of measurement can be generated from stored and incoming data, plus use as a system controller is possible. Thus, whatever measuring instrumentation is employed, the 2313 opens up a whole new range of measurement possibilities and applications.

Description

Writing System

The writing system of the 2313 accepts 210 mm wide rolls of electrosensitive paper QP 4690. Two 50 m rolls are supplied with the Recorder, each providing the equivalent of 160 A4 (metric) size charts. The paper is of the readily available metallized type and produces clear well defined print that is not susceptible to fading as with chemically treated types.

When loaded in the 2313, the metallized surface of the paper contacts a fixed, single-element, print head. This is accessible via the paper outlet slot on the front panel to facilitate easy cleaning and to achieve a high resolution print has 512 individual electrodes. These are spaced at 0,4 mm intervals and span almost the complete paper width giving a maximum line width of 205 mm.

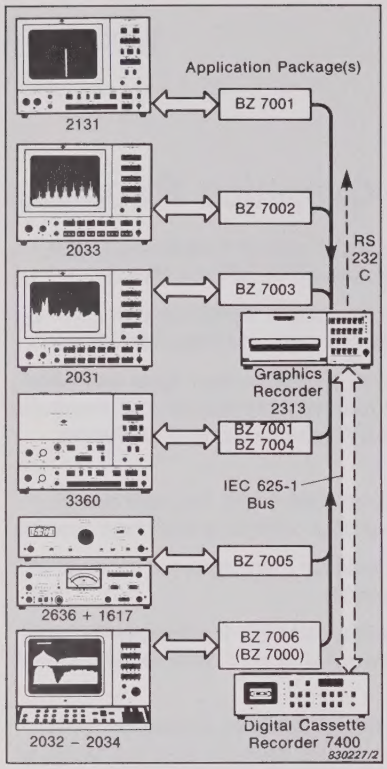


Fig. 1. Interchangeable Application Packages for use of different Digital Frequency Analyzers with the 2313

For well formed characters and graphics, the paper is evenly accelerated and decelerated past the print head in 0,2 mm steps. Utilizing the plot mode for 512-point graphics, the maximum print rate is 46 lines per second. Due to the relatively smooth transition from one line to the next, relatively quiet operation is obtained.

In the print mode a total of 96 standard upper and lower case characters may be called on, plus 32 special characters. These are according to ISO 646 and 2022 standards respectively, and are based on a 6 by 8 point matrix. For enhancing different text four character sizes up to 12,8 mm may be chosen, which enable between 46 and 85 characters per line to be printed. In addition line spacings between 0,4 and 2,8 mm may be selected. The print rate depends on the size and number of characters printed and is between 3 and 9 lines per second.

If required text and graphics can be mixed by changing from the print to plot mode (or vice versa) at the start of a new line. Text and graphics may also be justified to the left or right margin of the paper and for filing in standard binders there is a "Page Feed" function for advancing the paper the remainder of one A4 or 11 inch chart.

Application Packages

As standard the Application Package BZ 7000 is included with the 2313. This plugs directly into a port on the front of the Recorder and facilitates use of the 2313 as a conventional alphanumeric/graphics printer as well as permits direct copying of spectra presented on the display screen of the B&K Dual Channel Signal Analyzers Types 2032 and 2034.

Also for use with the 2313 are the Application Packages BZ 7001 to BZ 7006. These are available as extra and especially convert the 2313 to suit the individual documentation needs of the B&K Digital Frequency Analyzers shown in Fig. 1. Furthermore they provide a range of special functions for storage and reformatting data, which enable new types of measurement to be made using the analysis equipment shown.

Note: For direct copying of measurements presented on the display screen of the B&K Dual Channel Signal Analyzers Types 2032 and 2034, any Application Package may be employed, including BZ 7000.

Documentation

Common to all Application Packages, except BZ 7000, are "List" and "Plot" functions. Both are selectable using the pushkeys of the Recorder and provide fully annotated, hard-copy documentation of measured frequency spectra and/or time domain functions in as little as 10 seconds. Examples of the two types of documentation are shown in Fig.2 and 3 respectively. Generally graphic plots of spectra resemble those presented on the display screen of B&K Digital Frequency Analyzers, except that they also have fully annotated measurement axes and include front panel control setting information plus the date and time of the readout.

If desired two separate spectra can be plotted simultaneously. Also, documentation may be modified to suit the specific signal analyzed. The latter is accomplished by selecting any one of three independent "Operating Set-ups" stored in the Recorder. These provide access to the different control functions of the particular package employed, permitting the user to change or select individual control parameters using the pushkeys of the Recorder. For example, different amplitude axes and offsets may be chosen or autoranged to correspond with the maximum signal level, only data within a user-defined frequency

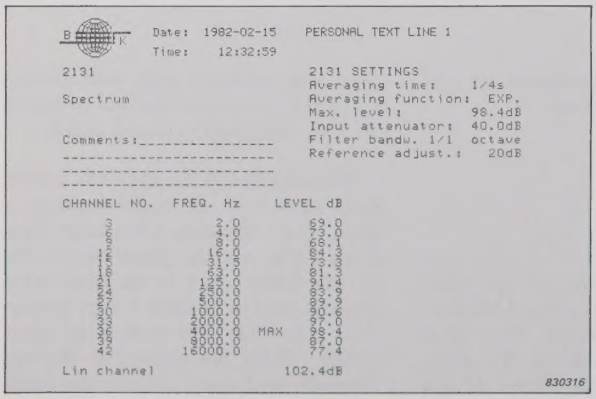


Fig.2. Typical listing of 1/1 octave analysis data, printed by the 2313 Graphics Recorder with Application Package BZ 7001

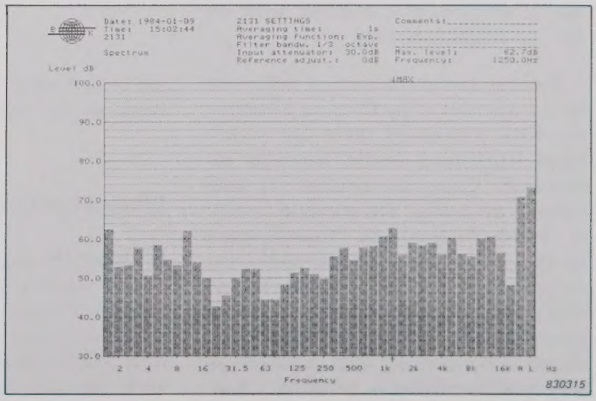


Fig. 3. Typical 1/3 octave analysis, printed by the 2313 Graphics Recorder with Application Package BZ 7001

range printed, and measurement axes graduated directly in dB and Hz or standard engineering units of Pa, ms^{-2}, mV etc.

Storage

The 2313 includes both continuous and volatile memories. These enable measured spectra and other data transmitted by particular equipment for which the Application Package is designed, to be individually filed during the course of measurements. Stored spectra may then be recalled at some other time for comparison with later incoming data or may be saved and reformatted for new types of measurement.

With the continuous memory approximately ten sets of complete spectra may be stored, whilst with the volatile memory storage of several hundred sets is possible (see Specifications). Also, a 100 step pushkey sequence can be entered, enabling a whole series of measurement, storage and documentation functions to be carried out completely automatically. For identification and quick location of data, a "Memory Menu" function can be activated which lists file numbers along with other main data concerning stored measurements.

To help safeguard stored data, special provision is made for securing consecutive memory files. Whereas the volatile memory is intended only for temporary storage, data stored in the continuous memory can be retained more-or-less indefinitely provided that the 2313 is subjected to regular use.

Measurements

An important feature of the 2313 is that it is capable of reformatting stored and incoming spectra, enabling new types of measurement to be documented, without having to use or especially program other equipment for the purpose.

The different types of measurement available cover production of sum, difference and average spectra, sound contour and 3D plots, 3-parameter (amplitude/frequency/time) mapping of single events etc. Furthermore, 1/1 or 1/3 octave spectra may be assembled from narrow-band data transmitted by Frequency Analyzers Types 2031 and 2033, or a 1/12 octave – 4 pass analysis carried out in conjunction with Frequency Analyzer Type 2131. See Fig.4 and Specifications.

Stored spectra may also be individually modified using the pushkeys of the Recorder. This is valuable for eliminating unwanted components, as well as for generating different reference spectra for comparison with incoming data.

Built-in Clock

All internal operating sequences are governed by a built-in clock generator. For data logging purposes there is a calendar function enabling both date and time to be automatically recorded at the head of each data file stored or documented with the Recorder. If need be the clock may be set to initiate a series of readouts at preselected intervals ranging from 1s to 24 hours, and/or start a control sequence after both a preset level and time have been exceeded. This is useful in airport noise surveys, machine surveillance for preventive maintenance etc.

Fig. 6. Alphanumeric characters available with the 2313 Graphics Recorder

Digital Interface and System Control

System control, plus digital input and output of measurement data, takes place via the IEC/IEEE Interface of the 2313. This enables a large number of instruments with compatible interface to be connected directly on-line with the Recorder. However, where more than digital input of data and manual operation of the measuring system is required, the 2313 must be fitted with an Application Package other than BZ 7000.

A notable feature of the Application Packages BZ 7001 to BZ 7006, is that they permit all information transfer over the IEC /IEEE bus of the measuring system to be governed by the

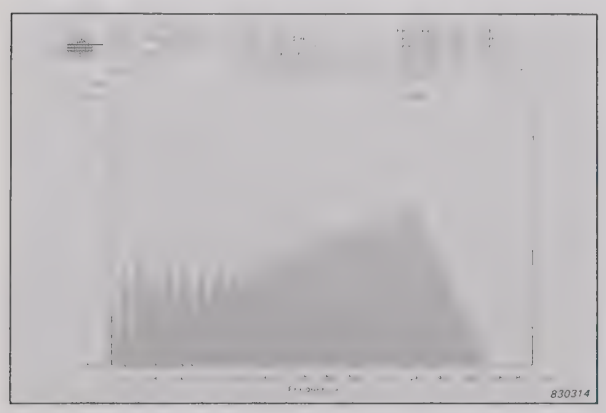


Fig. 4. Typical 1/12 octave – 4 pass analysis obtained using the 2313 Graphics Recorder with Application Package BZ 7001

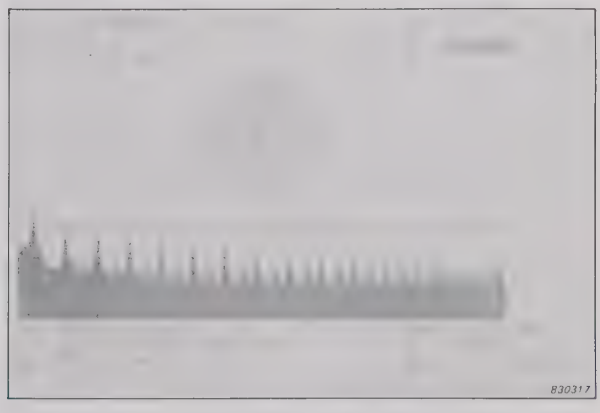


Fig. 5. Typical plot of the 2032 (or 2034) Signal Analyzer display as copied using the 2313 as a conventional graphics printer with BZ 7000 or any other Application Package fitted

2313. As a result the entire measurement system may be operated via the interface and front panel pushkeys of the Recorder. For instance, using a simple pushkey command, measurements displayed on the Frequency Analyzer may be sent to the Recorder for documentation or storage, or if required may be relayed to another device such as a 7400 Digital Cassette Recorder. Similarly, tape recorded data may be documented or stored in one of the continuous or volatile memories of the 2313, provided that this originates from the Frequency Analyzer for which the Application Package is designed.

Provided along side the IEC interface, is an RS 232C Serial Interface. This provides a secondary means of remote control of the 2313 and other equipment covered by its Application Package, plus permits entry of personal text in the documentation presented by the Recorder (see Fig. 4). Alternatively, personal text may be entered via the front panel pushkeys of the 2313.

Specifications 2313

WRITING SYSTEM:
Dot-matrix printing on Metallized Paper QP 4690 using fixed 512-point print head with line width of 205 mm

Print Mode:
96 standard plus 32 special 6 by 8 matrix characters according to ISO 646 and 2022
Characters per Line: Selectable between 46 and 85
Character Height: Selectable 1,6; 3,2; 6,4 or 12,8 mm
Line Spacing: 0,4 to 2,8 mm
Print Rate: 3 full lines of 3,2 mm high characters per second corresponding to 250 characters per second

Graphics Mode:
Resolution: 25 dots/cm (63 dots/in)
Line Width: 204,4 mm
Line Spacing: 0,2 mm
Print Rate: 46 lines per second

PAPER DRIVE:
Step Length: 0,2 mm
Chart length: 297 mm A4 (metric) or 11 in (English) chart length
Page: Advances paper remainder of selected A4 or 11 in chart
Out of Paper: Warning printed plus paper drive automatically terminated at end of paper roll

IEC 625-1 STANDARD INTERFACE:
For system control plus digital input and output of data to be documented.

Connector: Standard 25-pin connector accepting Cable AO 0194 for connection to an IEC 625-1 interface system. Connection into an IEEE 488 interface system is made using Cable AO 0264, or Cable AO 0194 plus Adaptor AO 0195
Functions Implemented: Source Handshake (SH 1), Acceptor Handshake (AH 1), Talker (T 5), Listener (L 3), Service Request (SR 1), Remote Local (RL 1), Parallel Poll (PP 1), Device Clear (DC 1), Controller (C 1 to 5)
Transmission Speed: ~100 kbytes/s with direct memory access
System Control: Manual operation or use as system controller in accordance with Application Package
Job Specifications: Accepts job specification commands in IEC 625-2/IEEE Std. 728 format

RS-232C SERIAL INTERFACE:
For digital input of personal text

Connector: 25-pin (female) wired as DCE device
Transmission Speed: Selectable up to 9600 Baud

REMOTE CONTROL:
8-pin DIN socket providing make and break lines for control of external sound source, audible alarm, warning lamp etc. Maximum throughput 0,25 mA/200V

TEMPERATURE RANGE:
Operation: 5 to 40°C (41 to 104°F)
Storage: –25 to 70°C (–13 to 158°F)

HUMIDITY: up to 90% RH (non condensing) at 30°C

ELECTROMAGNETIC COMPATIBILITY:
Complies with Class B Device of the American FCC Rules

POWER REQUIREMENTS:
Complies with IEC 348 Safety Class II
Supply Voltage: 100; 115; 127; 200; 220; 240 V (50 to 60 Hz) ±10% AC
Power Consumption: 60 VA nominal (160 VA max. instantaneous)

CABINET:
Supplied as Model A (light-weight metal cabinet) or Model C (as A but with flanges for standard 19 in rack)

DIMENSIONS:
Metal cabinet, excluding knobs and feet
Height: 177 mm (7,0 in)
Width: 430 mm (16,9 in)
Depth: 500 mm (19,7 in)

WEIGHT: 17 kg (37,5 lb)

ACCESSORIES INCLUDED:

1 × Mains Cable	AN 0020
2 × 50 m Roll of Recording Paper	QP 4690
1 × 8-pin DIN Plug	JP 0802
1 × 25-pin IEC 625-1 Bus Connector Kit	UA 0793
1 × 25-pin RS-232C Male Connector	JP 2500
1 × Application Package	BZ 7000

ACCESSORIES AVAILABLE:

50 m Roll of Recording Paper	QP 4690
25-pin IEC 625-1 Interface Cable (2 m)	AO 0194
25-pin IEC (male, slide-lock) to IEC 625-1 Interface Cable (2 m)	AO 0184
25-pin Adaptor for coupling into IEEE 488 Interface System	AO 0195
25-pin IEC 625-1 to IEEE 488 Interface Cable (2 m)	AO 0264

APPLICATION PACKAGES AVAILABLE:

BZ 7001 for Digital Frequency Analyzer Type 2131 and Sound Intensity Analyzer System Type 3360. Lists and plots 1/1 and 1/3 octave spectra. Stores 302 spectra plus 1 auto. control sequence. Generates "Lin" and "A"–weight channel – adds, subtracts and averages spectra – multiple plots of up to 40 spectra – 1/12 octave analysis – reverberation and decay measurements – 3-parameter (amplitude/frequency/time) maps. Clock, trigger and wait functions also included.

BZ 7002 and 7003 for Digital Frequency Analyzers Type 2033 and 2031 respectively. List and plot time functions and narrow-band spectra. Store 62 spectra or 26×1k (2×10k) time functions, plus 1 auto. control sequence. Generate "Lin" and "A"-weight channel – 1/1 and 1/3 oct. spectra – distortion spectra – average spectrum and standard deviation. Also integration and differentation functions, as well as choice of auto-scaling and engineering units.

BZ 7004 for Sound Intensity Analyzer System Type 3360. Similar to BZ 7001 but with sound power measurements, sound contour and 3D plots (pressure and intensity), plus source localization (with Digital Cassette Recorder Type 7400) instead of 3-parameter mapping, average and multiple plots.

BZ 7005 for Measuring Amplifier Type 2636 plus Band Pass Filter Type 1617. Similar to BZ 7001 but with L_{eq} measurements, autoranging of 2636, remote control of 1617 and BT product instead of trigger function, 1/12 octave analysis, reverberation and decay measurements and multiple plots.

BZ 7006 for Dual Channel Signal Analyzers Types 2032 and 2034. Adds 1/1 and 1/3 Oct. synthesis plus envelope analysis functions to Analyzer. Provides automatic input and output to a connected Digital Cassette Recorder Type 7400. The 2313 plot functions are expanded to include display and plot of two sumperimposed curves, as well as several user-definable plot modications.

For more detailed information and specifications concerning the respective Application Packages, please ask for their separate Product Data Sheets.

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*BZ 7000 permits use as a conventional alphanumeric printer plus direct copying of measurements displayed on Analyzers Type 2032 and 2034. For graphic plots with other B&K Analyzers, the Application Packages listed under Accessories Available should be employed.

2. CONTROLS

2.1. FRONT PANEL

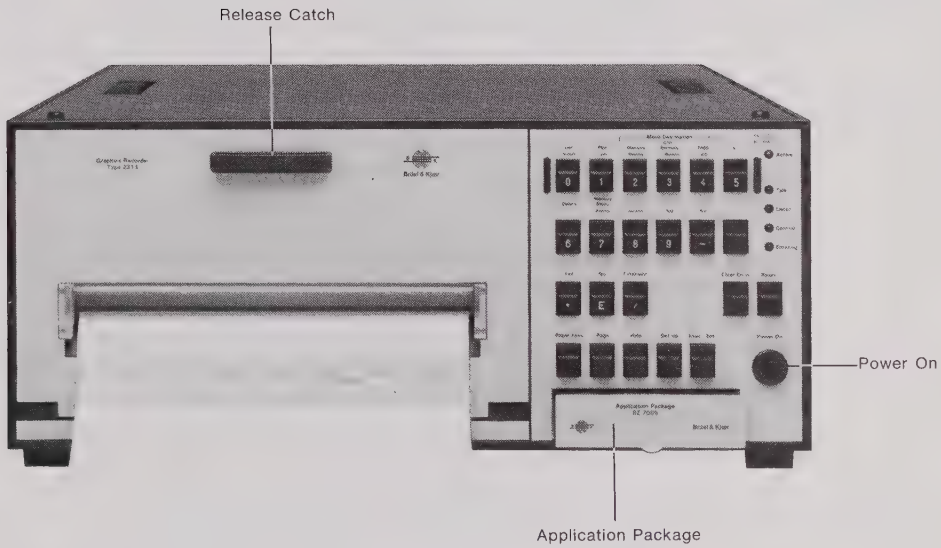


Fig. 2.1. Front panel of the Graphics Recorder Type 2313

Power On: On-Off switch for mains power. When set to **Power On**, either the **Active** or **Entering** LED on the right of the top two rows of front panel pushkeys should light, accompanied by a print out of date and time.

Release Catch: Press down and pull to hinge forward the paper drive mechanism. See section 3.7 for details on paper loading and cleaning of the print head.

Application Package: Plug-in module determining which operating functions are available with the Recorder, plus which measurement and analysis equipment the Recorder may be used with. For documentation, storage and processing of measurement data transmitted by the B&K Measuring Amplifier Type 2636 and Band Pass Filter Type 1617, the Application Package BZ 7005 is employed. See section 3.6.

At the top right of the instrument are two rows of pushkeys. These are shown in Fig. 2.2 and are for keying in numerical data with the **Set-Up** mode of the Recorder, plus specifying memory and tape files to and from which measurement data is to be relayed for documentation and storage etc.

In addition, the pushkeys enable different functions and sub-functions to be chosen with the Recorder. These depend on the particular Application Package employed and are printed on a Control Function Overlay included with each package. The Overlay is a

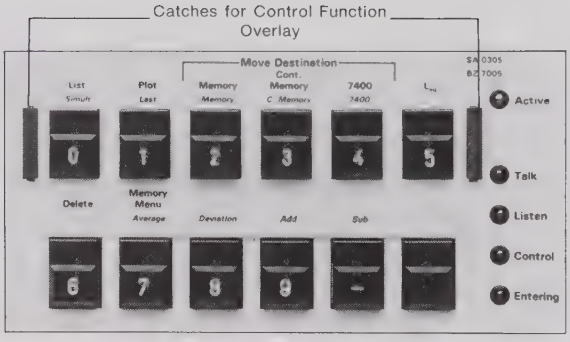


Fig. 2.2. Top two rows of pushkeys on the Graphics Recorder Type 2313 fitted with the Control Function Overlay SA 0305 belonging to Application Package BZ 7005

small oblong sheet of plastic and fastens between the catches on either side of the keys as indicated in Fig.2.2.

For operation with Application Package BZ 7005 the appropriate Control Function Overlay is SA 0305. Functions and sub-functions selectable using a single key stroke are indicated directly on the overlay and are headed by plain and cursive text respectively to help distinguish between them. Generally, functions are used to specify a destination (**Plot** spectra, for example) and may be selected when the **Active** LED beside the pushkeys is lit (see section 4.2), while sub-functions are used to specify a data source (**7400**, for example) and may be chosen following selection of a function when the **Entering** LED is lit (see section 4.3).

Functions selectable using a single key stroke, are as follows:

List [0]: Generates hard-copy listing of a measured 1/1 or 1/3 octave spectrum or Leq measurement from the 2636 and 1617. Alternatively, any spectrum, Leq measurement or time history which has been stored or statistically processed by the 2313 may be listed. See section 4.2.1.

Plot [1]: Generates hard-copy fully annotated plot of a measured 1/1 or 1/3 octave spectrum from the 2636 and 1617. Alternatively, any spectrum or time history which has been stored or statistically processed by the 2313 may be be plotted. See section 4.2.2.

Move to Memory [2] or **Move to C. Memory [3]:** Store measurement from the 2636 and 1617 (or one already processed or stored using the 2313) in a volatile or continuous memory file of the Recorder. See sections 4.2.3 and 4.2.4 respectively.

Move to 7400 [4]: Stores measurement from the 2636 and 1617 (or one already processed or stored using the 2313) in a tape file on the 7400 Digital Cassette Recorder. See section 4.2.5.

Leq [5]: Initiates Leq measurement with 2636 plus lists result. See section 4.2.6.

Delete [6]: Deletes measurement stored in any one or group of non delete-secured memory files of the 2313, or all files of a non write-protected tape cassette on the 7400. See section 4.2.7.

Memory Menu [7]: Produces short-form contents list of any one or group of memory files of the 2313, or of a tape file selected on the 7400. See section 4.2.8.

Sub-functions which may be selected using a single key stroke when the **Entering** LED is lit, are:

***Simult* [0]:** A sub-function of **Plot** for documenting any two measured spectra or time histories of the same type, which are stored in the volatile memory of the 2313. See section 4.3.5.

Last* [1]:** Selects ***Last memory as the data source for repeating the previous operating function entered or performing a new function using previous data. See section 4.3.1.

***Memory* [2]:** Selects the volatile memory as the data source for documenting, storing or deleting stored measurements depending on the particular destination or function selected. See section 4.2.3.

***C. Memory* [3]:** Selects the continuous memory as the data source for documenting, storing or deleting stored measurements depending on the particular destination or function selected. See section 4.2.4.

***7400* [4]:** Selects the 7400 Digital Cassette Recorder as the data source for documenting, storing or deleting tape recorded measurements provided that these have been previously processed by BZ 7005. See section 4.2.5.

***Average* [7]:** Sub-function for averaging a number of measured spectra or time histories of the same type, which are stored in consecutive volatile memory files of the 2313. Either arithmetic averaging or averaging in dB form may be selected. See section 4.3.2.

***Deviation* [8]:** Determines the standard amplitude deviation of a number of measured spectra or time histories of the same type, which are stored in consecutive volatile memory files of the 2313. See section 4.3.3.

***Add Spectra* [9]**
or
***Sub. Spectra* [–]:** Add or subtract any two measured spectra or time histories of the same type, stored in the volatile memory of the 2313. Either arithmetic summation or summation in dB form may be chosen. See sections 4.3.4 and 4.3.6.

Due to limited space certain functions and sub-functions are not indicated on the Overlay. These are chosen using two or more separate key strokes as indicated below. Functions making use of the **Extension [/]** key are termed extended functions and like the main functions may be selected when the **Active** LED is lit. See in section 4.4.

***Time History* [22]:** Sub-function for listing or plotting the time history of any single frequency or weighting band of a series of 1/3 or 1/1 octave spectra (or Leq measurements), which have been stored in consecutive volatile memory files of the 2313. Up to 160 single band measurements may be documented at one time and are stored as a single file in the last memory. See section 4.3.7.

Personal Text [/] [100]: Permits entry of up to five lines of personal text in the control heading of measurements documented with the 2313. Text is stored in the continuous memory of the Recorder and is entered in ASCII coded form via the front panel pushkeys or over the IEC/IEEE or RS-232C **Interface** on the rear panel. See section 4.4.1, 6.6.13 and 7.1.2 respectively.

Execute 7400 Program [/] [101]: Stores and/or activates a soft-function in a special volatile memory file of the 2313. Soft-functions are available in Digital Tape Cassette form for replay with the 7400 and extend the choice of measurement functions available with the 2313. See section 4.4.2.

Store 7400 Program [/] [102]: Initiates storage in a 7400 tape file of a soft-function stored in the volatile memory of the 2313. Permits work-copy to be made of B&K Soft-Function Tape Cassettes. See section 4.4.3.

Enter Sequence [/] [104]: Stores a 250-step user-defined control sequence made up of different measurement, storage and documentation functions selectable with the front panel pushkeys of the 2313. The sequence is stored in a specially allocated continuous memory file and is automatically deleted when **Enter Sequence** is selected for recording a new sequence. See section 4.4.5.

Execute Sequence [/] [103]: Activates key push sequence stored using the **Enter Sequence** function of the 2313. Permits a whole series of measurement, storage and documentation functions to be carried out fully automatically. See section 4.4.4.

Edit Sequence [/] [105]: Selects stored key push sequence enabling it to be updated without first deleting the entire sequence. See section 4.4.6.

Shift Function [/] [106]: Updates control parameters of key push sequence stored with the **Enter Sequence** function. Permits automatic stepping of file number, frequency band, etc. See section 4.4.7.

Wait [/] [107]: Delays activation of one or more functions of a stored control sequence by a multiple of the entered time. Is used in conjunction with the **Enter Sequence** function. See section 4.4.8.

Wait Clock [/] [108]: Similar to **Wait** except that activation of a stored control function is delayed until the built-in clock corresponds with entered time (Hour-/Minute/Second). See section 4.4.9.

Calibrate [/] [109]: Checks the calibration of the 2636, plus automatically corrects the readout of 2313 for accurate readout of measured levels. See section 4.4.10.

Relay On [/] [110]
and
Relay Off [/] [111]: Permit remote switching of an external sound source, audible alarm etc., connected via the **Remote Control** socket on the rear panel of the 2313. They may be used in conjunction with the **Enter Sequence** for automatic execution of a measurement sequence. See sections 4.4.11.

Also available with BZ 7005 are a variety of common functions which determine the basic control settings selected for measurements. These are selectable via the internal Operating Set-Ups of the Recorder and are as follows:

Add Lin. and W [200]: For inclusion of the "Lin." plus "A", "B", "C", or "D" frequency weighting band in 1/3 or 1/1 octave measurements performed by the 1617 and 2636 (see section 4.5.1). For Leq measurements the appropriate frequency weighting characteristic chosen with the **Filter** keys of the 2636 applies (see section 4.2.6).

Averaging [201]: For RMS linear averaging with choice of eleven fixed averaging time settings from 1/8 to 128 s or three constant confidence levels from $\sigma<0{,}5$ to $\sigma<2$ dB. Averaging is performed digitally by the 2313 and is used for 1/3 or 1/1 octave measurements involving both the 1617 and 2636 (see section 4.5.2). For Leq measurements the standardized "Fast" or "Slow" time weighting selected with the **Averaging** knob of 2636 applies (see section 4.2.6).

Filter [202]: Selects appropriate filter bandwidth for 1/3 or 1/1 octave measurements with the 1617 and 2636. See section 4.5.3.

Frequency [203]: Determines centre frequency range over which 1/3 or 1/1 octave measurements are performed with the 1617 and 2636. See section 4.5.4.

Autorange [204]: Provides choice of manual or automatic range switching with the **Input** and **Output Section Gain** of the 2636. May be used for Leq, as well 1/3 or 1/1 octave measurements. See section 4.5.5.

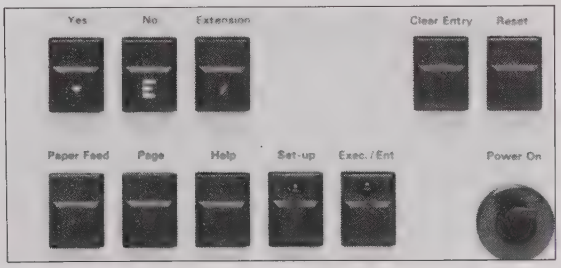
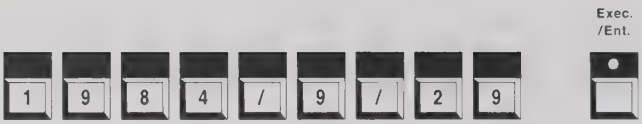


Fig. 2.3. Bottom two rows of pushkeys on the Graphics Recorder Type 2313

In Fig. 2.3 are shown the remaining pushkeys of the Recorder. These provide the functions described below and are not related to the particular Application Package employed.

Yes [.] and **No [E]:** For user communication and setting up of parameters with the Set-Up and Clock mode of the Recorder. The decimal point **[.]** and exponential **[E]** are secondary functions and are used when entering numerical data.

Extension [/]: Extends the choice of functions available with the top two rows of pushkeys. Is also used to separate functions, parameters and numerical data etc., in order that they may be entered as a single string instead of individually, e.g.



Clear Entry: Deletes last command or numerical data entered using top two rows of pushkeys. Permits false entry to be corrected prior to activating **Exec./Ent.**

Reset: Terminates selected function returning the Recorder to normal standby status. See section 3.8.1 for other types of reset available.

Paper Feed: Advances paper as long as pushkey is held depressed. If **Exec./Ent.** is activated while **Paper Feed** is held depressed an automatic self-test is initiated. See section 3.8.2.

Page: Advances paper the remainder of one full Metric or English page depending on the setting of the **Address Switch** on the rear panel.

Help: Activates print-out of short-form data and instructions to aid entry of commands and other data via the front panel pushkeys.

Set-Up: On-Off key, which initiates the setting up procedure for the different forms of read-out, measurements etc. The built-in LED of the key lights when the Set-Up mode is activated. See section 3.9.

Exec./Ent: Executes a command or terminates entry of data via the front panel pushkeys. The built-in LED of the key lights when **Exec./Ent.** is activated and command execution is in progress. Pressing **Exec./Ent.** immediately after a function has been executed will repeat the function and where pertinent will automatically update memory and tape file parameters etc. See introduction of section 4.2.

Active LED: Lights when the Recorder is used as a system controller (e.g. **Address Switch** set to "System Controller Active"), and data is not being entered. Indicates that the Recorder is ready to accept a function via the front panel pushkeys of the instrument.

Talk LED: Lights when the Recorder is sending data over the IEC/IEEE Interface.

Listen LED: Lights when the Recorder is receiving data over the IEC/IEEE Interface.

Control LED: Lights when the Recorder is sending IEC/IEEE control commands over the IEC/IEEE Interface.

Entering LED: Lights when the Recorder is ready to accept numerical data entered via the front panel pushkeys of the instrument or sent over the IEC/IEEE Interface.

2.2. REAR PANEL

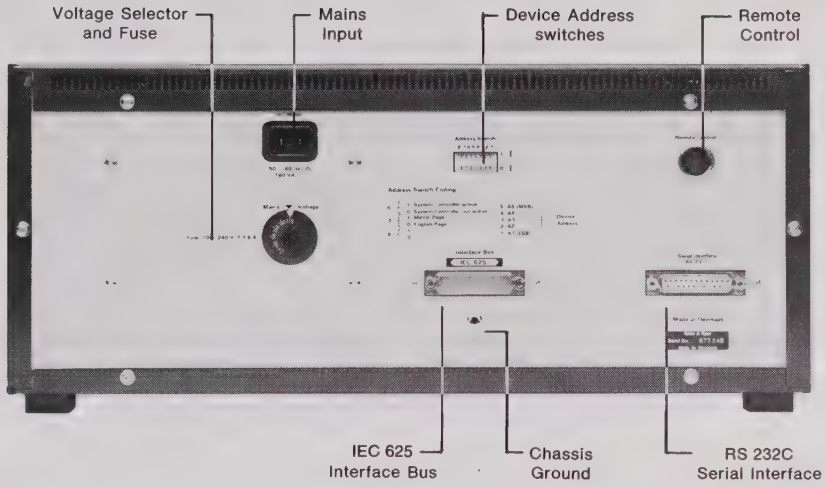


Fig. 2.4. Rear panel of the Graphics Recorder Type 2313

Address Switch: A set of eight miniature two-position rocker switches for manual selection of device address number with the digital interface bus of the 2313, plus selection of "System controller Active" or "Not Active" and "Metric" or "English" page length. On delivery the **Address Switch** numbers A5 to A1 are set to "00001" (ie., device address number 1). See sections 4.1. and 6.3.

IEC 625 Interface Bus: 25-pin connector conforming to IEC 625-1. Is for digital input and output of measurement data plus remote control of the measurement and recording system via a IEC 625-1 or IEEE 488 std. digital interface bus. See section 6.1 for appropriate interface cable.

RS 232C Serial Interface: 25-pin connector for digital input of personal text plus remote setting of the front panel pushkeys and operating set-ups of the Recorder via the keyboard of an RS 232C terminal. See Chapter 7.

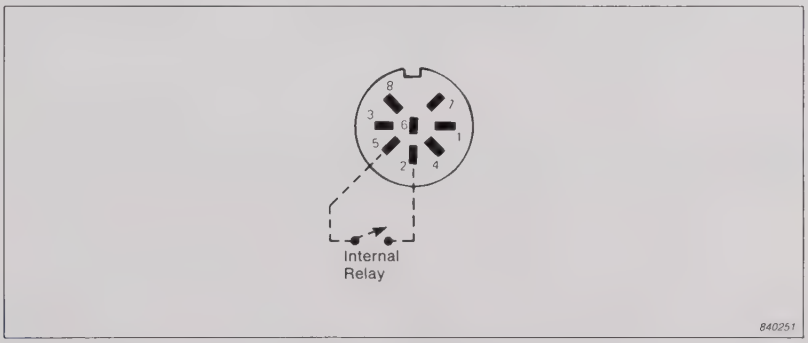


Fig. 2.5. External pin identities of the Remote Control socket of the 2313. In the standby condition (Relay Off) pins 2 and 5 of the socket are interconnected internally

Remote Control:

8-pin socket accepting the standard DIN plug (B&K no. JP 0802) with screw-lock provided. It permits remote switching of an external sound or noise source, such as the B&K Type 4224, and is used in conjunction with the **Relay On – Off** functions of BZ 7005 (see section 4.4.11). The relay has a maximum contact rating of 0,25 A, 200 V and 3 W respectively, and is connected with the **Remote Control** socket as indicated in Fig. 2.5.

Voltage Selector and Fuse:

Voltage selector for operation of the 2313 from a 100; 115; 127; 200; 220 or 240 V AC mains supply. The selector also contains a slow blow mains fuse. To select the appropriate voltage setting and fit the correct fuse, see section 3.3.

Mains Input:

2-pin socket, accepting the Power Cable AN 0020 provided, for connection of an AC mains supply. Before connecting a supply, the mains voltage setting and fuse checks given in section 3.3 should be carried out to ensure safe operation of the instrument.

3. PRELIMINARY

3.1. ENVIRONMENT AND HANDLING

The Graphics Recorder Type 2313 is designed for indoor use at temperatures from +5 to +40°C (+41 to +104°F) and humidities up to 90% RH (non-condensing) at 30°C. For safe operation avoid use in volatile environments and before each use of the instrument check that it is set to match the available supply voltage as described in section 3.3.

To ensure reliable operation, it is important that the following be observed:

- When first using the 2313 keep it powered for approximately 14 hours to prevent loss of data stored in its continuous memory.
- If the 2313 is not to be used for 4 weeks or more, disconnect the internal Ni-Cd battery used to power its continuous memory (see section 3.4).
- For optimal reproduction of printed data regularly clean the print head as described in section 3.7. Avoid use of chemical cleaning agents and sharp tools, as these can damage the head.

3.2. BENCH AND RACK MOUNTING

The 2313 may be used free-standing on its four plastic feet or, with the addition of the Flanges KS 0024 available, may be mounted in a 19 inch instrumentation rack. The flanges fasten via two screw holes at the front of the instrument side panels. These are accessible on easing back the bottom panel fastened by two screws on the rear of the instrument, and withdrawing the plastic corners and grooved strips at the front of the side panels. Before releasing the bottom panel ensure that 2313 is disconnected from the mains supply.

3.3. CONNECTION OF MAINS SUPPLY

Before connecting a mains supply, the following mains voltage setting and fuse checks should be carried out to ensure safe operation of the instrument.

Mains Voltage Setting:

The 2313 may be powered from 100, 115, 127, 200, 220 and 240 V ±10% (50 to 60 Hz) single phase AC mains lines. To select the correct mains voltage setting, use a small screwdriver to push in and release the fuse holder at the centre of the **Mains Voltage Selector** on the rear panel. Pull the fuse holder straight out and using a small coin or wide-blade screwdriver turn the selector disc so that the appropriate voltage setting lines up with the black arrow printed on the panel.

Fuse Rating:

To check or replace the mains fuse, release and withdraw the fuse holder at the centre of the **Voltage Selector**. For operation from 100 to 240 V AC supplies the fuse should be a 1,6 A slow blow (B & K no. VF 0007). Make sure that only fuses with the required rated current and of the specified type are used for replacement. The use of mended fuses and the short circuiting of fuse holders should be avoided.

Supply Connections:

Once the mains voltage setting and fuse have been checked, the mains supply may be connected to the **Mains Input** socket of the 2313 using the Power Cable AN 0020 supplied. The 2313 has a high standard of safety insulation in accordance with safety class II of IEC 348 and therefore its chassis need not be connected to mains ground.

3.4. CONNECTION OF CONTINUOUS MEMORY SUPPLY

Both the continuous memory and built-in clock of the 2313 are powered by a rechargeable Ni-Cd battery. As standard this is supplied already wired in the 2313, but to avoid unnecessary power drain during storage and shipment it is internally disconnected from the instrument.

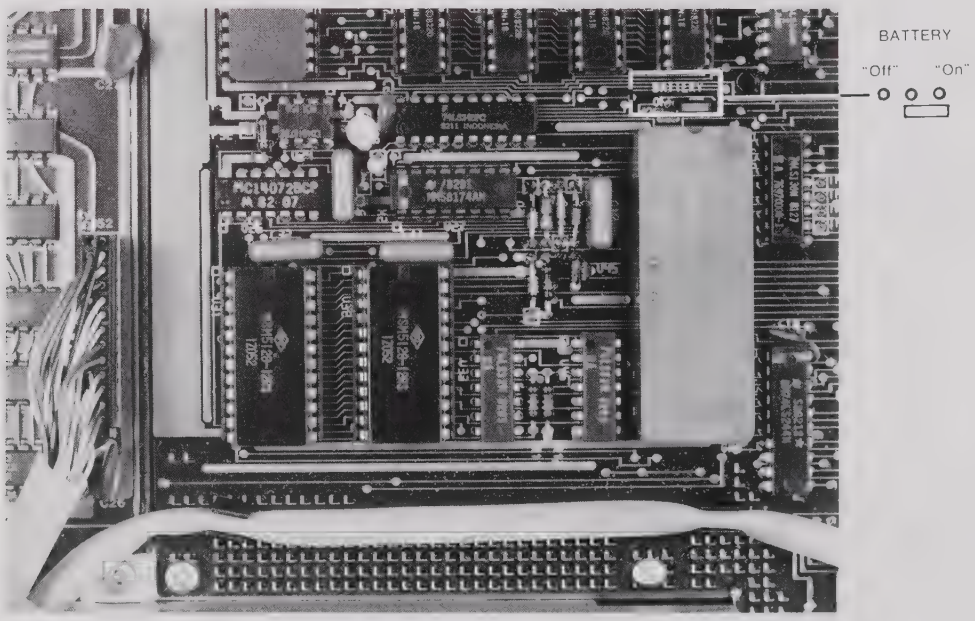


Fig. 3.1. Contact clip for connecting and disconnecting the internal Ni-Cd battery used for powering the continuous memory and clock of the 2313

To connect the Ni-Cd battery, disconnect the mains supply from the 2313 and remove its top panel which is fastened by two screws on the rear of the cabinet. The battery is located on the main circuit board on the base of the instrument. It may be connected by sliding off the contact clip from the group of three pins shown in Fig. 3.1 and using it to connect the centre pin and pin marked "On".

For recharging the Ni-Cd battery, the 2313 has its own charging circuit built-in. This is operative as long as the 2313 is operated from a mains supply and keeps the continuous memory powered more or less indefinitely provided that the 2313 is subjected to approximately 30 minutes use each day, 3,5 hours use each week or 14 hours use every 4 weeks. However, when using the 2313 for the first time it should be kept powered for at least 14 hours to ensure that the battery attains full charge capacity.

WARNING! To prevent damage to the battery ensure that it is regularly charged. If the 2313 is not to be used for more than 4 weeks, recharge the battery for approximately 14 hours and disconnect it as described above.

3.5. GROUNDING CONSIDERATIONS

Indiscriminate grounding of instruments can introduce ground loop interference. To prevent this influencing the measuring and analyzing instruments with which the 2313 is used it is important that the signal and digital ground lines of the instruments are grounded at one point only in the measurement system. To do this without prejudicing the operating safety of the instruments, proceed as follows:

1. Connect the signal ground lines of all instruments together. This is done automatically through the screens of the input and output cables used to interconnect the instruments.

2. Where the same instruments are interconnected by more than one signal cable or combination of signal and remote control cables each containing a signal ground connection, keep the cables short and close together or disconnect the signal ground line of all but one of them.

3. Where instruments are interconnected by a digital interface cable containing a chassis ground connection, check that one and only one of these instruments has its signal ground or digital ground connected to chassis.

4. Where the measurement arrangement is used free-standing without the instrument cabinets touching, check that each of the other instruments in the measurement arrangement has its chassis connected to a) mains ground only or b) signal ground or digital ground only. With instruments equipped with a mains connector having a protective earth-chassis contact, a) is to be preferred.

5. Where the measurement arrangement is mounted in an instrumentation rack, ensure that one and only one of the instruments has its signal ground or digital ground connected to chassis (and chassis connected to mains ground if equipped with a mains connector having a protective earth - chassis contact). If more than one of the instruments has a permanent signal ground - chassis connection, then isolate the cabinets of these instruments from the rack.

6. Finally, where the signal ground line is connected to mains ground via the mains connector of one of the instruments, isolate the housing of the measurement transducer from grounded measurement sources.

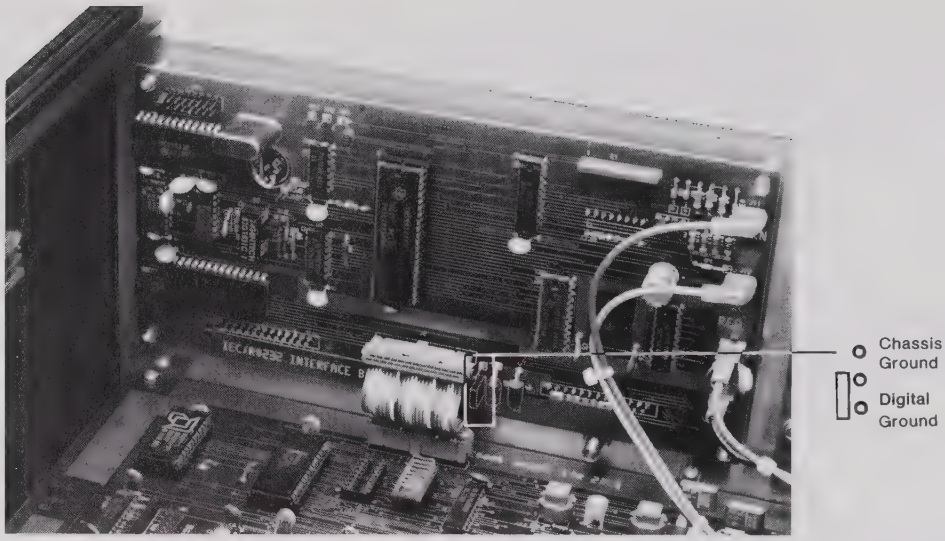


Fig. 3.2. The Digital and Chassis Ground contacts of the 2313

As standard the 2313 is delivered with its digital ground connected to chassis, which is that normally required for operation in most instrument set-ups. However, where the above grounding requirements dictate otherwise, they may be disconnected from one another by carefully easing off the contact clip from the interface board contacts shown in Fig. 3.2 and using it to connect the top and middle contacts indicated. The interface board is mounted on the rear panel and is accessible on sliding off the top panel which is fastened by two screws at the back of the instrument. Before removing the top panel ensure that 2313 is disconnected from the mains supply.

WARNING! The 2313 is designed to be operated with its digital ground and chassis at zero earth potential. Never let the signal ground terminals, socket screens or chassis float at other than approximately zero earth potential, as this will impair the operating safety of the apparatus and may damage it.

3.6. INSTALLATION OF APPLICATION PACKAGE

Application Package BZ 7005 especially converts the 2313 for documenting, storage and processing of measurement data transmitted by the B&K Measuring Amplifier and Band Pass Filter combination Type 2636 and 1617. In addition, it permits use of a Digital Cassette Recorder Type 7400 in the analysis set-up, thus enabling measurement results and control setting data to be stored on tape for documentation and processing by the 2313 at a later date. For operation with other B&K measurement and analysis equipment, one of the other Application Packages available for the 2313 should be employed. See Chapter 1.

Memory Check:

Before replacing an Application Package with BZ 7005, the contents of the continuous and volatile memories of the 2313 should be checked using the **Memory Menu** function (see section 4.2.8). If important data from previous measurements is present, then it should be recorded on tape as described in section 4.2.5. This is necessary as stored data will be automatically deleted when BZ 7005 or another Package is fitted.

Installation of Package:

Having carried out the above check, the Application Package may be replaced by BZ 7005. To do this set the **Power On** switch of the 2313 to "Off", unscrew the captive fastening on the front of the Package and use this to pull the Package out of the Recorder. BZ 7005 may then be inserted and its Control Function Overlay SA 0305 clipped over the top row of front panel pushkeys as indicated in Fig. 3.3. For protection from dust and other foreign matter never leave the Recorder without a Package fitted and remember to store Packages not in use in their mahogany case together with their Control Function Overlay.

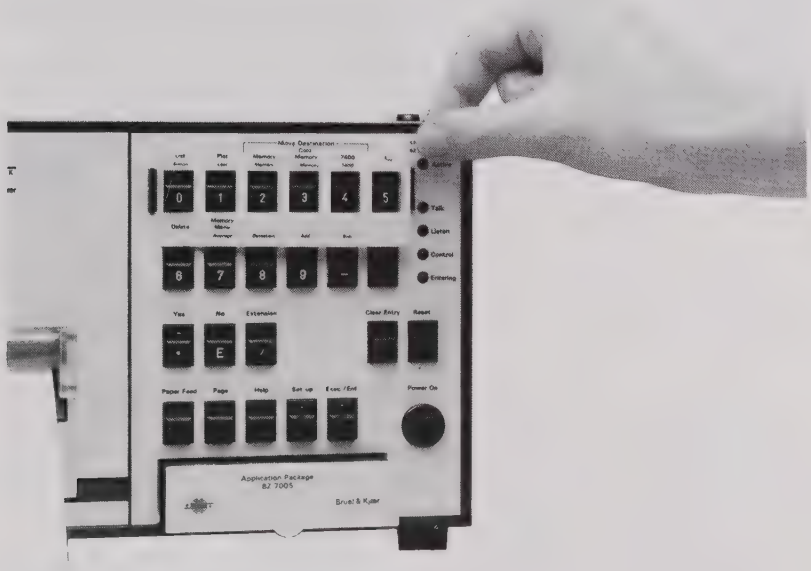


Fig. 3.3. Fitment of Application Package and Control Function Overlay

3.7. PAPER LOADING AND CLEANING

To load the 2313 with a fresh roll of Paper QP 4690, proceed as follows:

1. Press down the **Release Catch** on the front panel and pull forward the paper drive frame as shown in Fig. 3.4.

2. Lower the **Release Arm** on the left of the drive frame and lift out the paper spindle together with the remainder of the old paper roll if one is fitted.

3. Wipe a soft lint-free cloth along the rear of the print head to remove traces of print dust which may have accummulated during previous use. See Fig. 3.5.

4. Slide a fresh roll of Paper QP 4690 onto the paper spindle and hold it just in front of the drive frame as shown in Fig. 3.4.

5. Push each end of the paper spindle into the empty **Take-Up Slots** on either side of the drive frame and check that the spindle clips fast on the ball-catches in the slots.

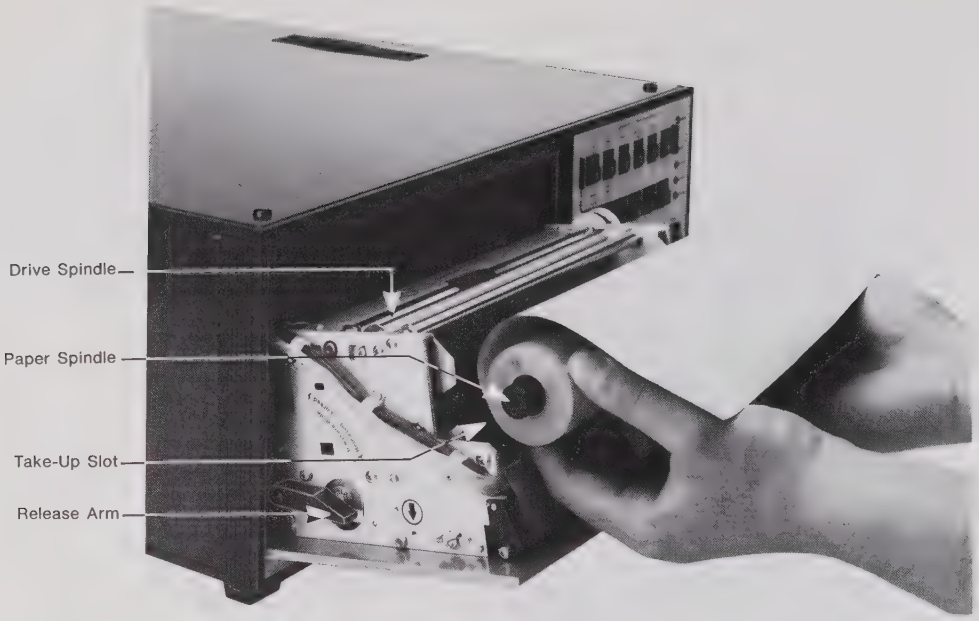


Fig. 3.4. The Paper Drive Frame of the 2313

6. Remove the adhesive seal and pull out approximately 30 cm (12 in) of paper from the roll.

7. Carefully feed the free end of the paper between the guide and drive spindles until it protrudes from the opening on the front panel of the drive frame.

8. Lightly pull the free end of the paper to take up any slackness and raise the **Release Arm** on the left of the drive frame to lock the pressure spindle.

9. Hinge up the front of the drive frame so that it is flush with the front panel of the 2313 and push the **Release Catch** up to lock.

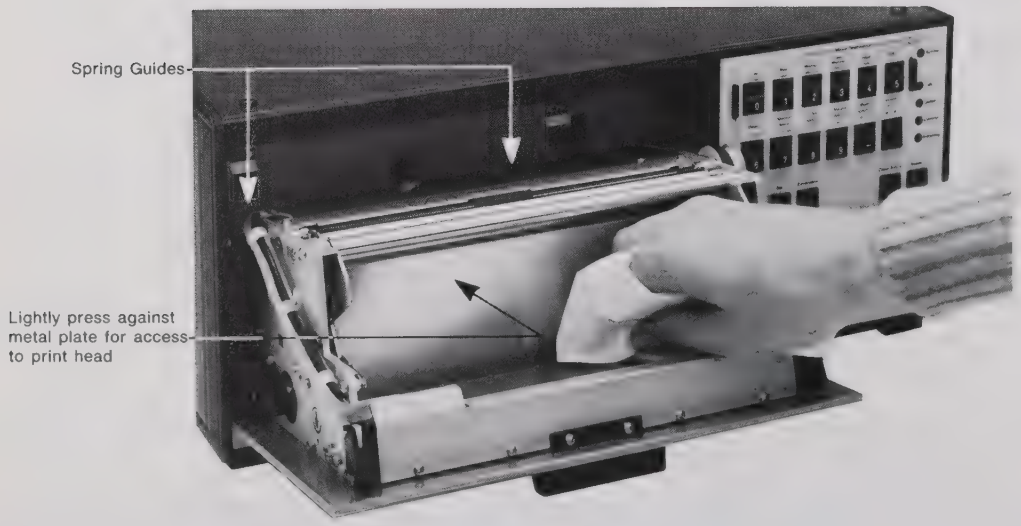


Fig. 3.5. Cleaning the Print Head of the 2313

Test Print:

After loading a roll of recording paper it is recommended that the Self-Test mode of the 2313 be activated as outlined in section 3.8.2. Provided that Recorder is functioning correctly it should generate an exact replica of the test print shown in Fig.3.6.

Cleaning the Print Head:

Should the test print show signs of uneven printing or lack contrast, then it is likely that there are traces of print dust embedded on the print head. These may be removed by lightly brushing the print head with a soft bristled tooth brush and wiping with a lint-free cloth as shown in Fig. 3.5. For access to the head remove the paper and gently press the metal plate at the back of the writing system 1 or 2 mm away from the head.

Cleaning of Paper Feed Spindles and Rollers:

The two metal spindles which make contact with the metallized side of the paper act as common current contacts. If the spindles become covered by a grey deposit, bad contact may occur which will reduce the overall printing contrast. The deposit may be removed using ordinary metal polishing paste or liquid.

If the paper slips during printout then there is insufficient friction between the paper and the rubber roller. To restore normal friction remove paper dust from the roller using a soft cloth lightly moistened with alcohol.

Paper Feed Alignment:

Should the paper start to crease at either its left or right-hand edges during printout, then it is likely that the spring guides at the rear of the writing system compartment require realignment (see Fig. 3.5). Normally this is not a frequent occurrence and can easily be rectified by gripping the bottom of the guide nearest the faulty edge of the paper and bending it out slightly to ensure proper contact with the paper when the writing system is folded back into the Recorder.

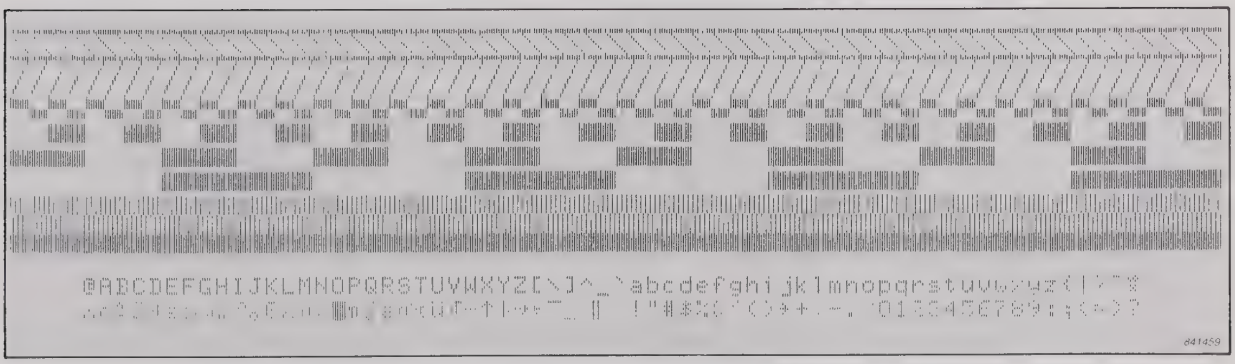


Fig. 3.6. Test print obtained using the self-test mode of the 2313

3.8. USE OF RESET AND AUTOMATIC SELF–TEST

3.8.1. Reset

Using the 2313 three types of reset are available for returning the instrument to normal standby or power on status. These are:

Normal Reset:

This is activated by pressing the **Reset** key and is useful for quickly terminating execution of a documentation, storage or measurement task following selection of an incorrect function or one which is not self terminating. In such circumstances, pressing **Reset** will return the 2313 to normal standby status where selection of a new function is possible.

Another use of the **Reset** key is in ensuring that the 2313 always selects the appropriate control mode after alteration of its **Address Switch**. In addition, it is capable of restoring normal operation when the Recorder is blocked by a minor malfunction or mains interference. However, whether this use of the **Reset** key is successful or not, depends on type of disturbance. If not, one of the other types of reset described should be employed.

Power On Reset:

Power on reset is obtained by selecting **Power Off** for a couple of seconds and then selecting **Power On**. This returns the 2313 to its initial power on status, deleting measurement data stored in its volatile memory. If desired a *power on reset* can be performed as part of Self-Test, which is described in section 3.8.2.

Hard Reset:

The most powerful type of reset available with the 2313 is obtained by pressing the **Paper Feed** key and whilst keeping it pressed, momentarily pressing **Reset**. This performs a *hard reset* which resets the entire instrument including its built-in clock, plus deletes all measurement data in its volatile and continuous memories. A *hard reset* should therefore only be performed after having tried the other methods of reset described.

If the 2313 fails to respond correctly even to a *hard reset*, it is likely that a more serious fault has occurred. To check the Recorder plus the Application Package the Self-Test mode discussed in section 3.8.2 can be employed.

3.8.2. Automatic Self-Test

For checking the correct function of the 2313, including its Application Package, it is equipped with a Self-Test mode.

Actuation of Self-Test:

Self-Test may be activated in two ways with slightly different result. The simplest way is by pressing the extreme right-hand key in the second from top row of pushkeys and while keeping it depressed, momentarily pressing **Reset**. This initiates the test cycle described below and on completion of the tests performs a *power on reset* which re-

turns the Recorder to normal power on status plus deletes measurement data stored in its volatile memory.

Where it is important that stored data not be deleted, Self-Test can be activated to provide a print out of a test chart instead. This is generated at the start of the test cycle and is useful in checking the writing system of the Recorder (see section 3.7). It is chosen by pressing the **Paper Feed** pushkey and while keeping it depressed, pressing **Exec./Ent.** However, first it is important that the "System Controller Active" mode be selected by setting **Address Switch** pair number 8 on the rear panel to "1" (see Fig. 4.2.) and pressing the **Reset** pushkey.

Self-Test Sequence:

Having carried out the above, the Self-Test mode lights all five control LEDs in the top right corner of the front panel and proceeds to check the electronic circuitry of the Recorder and Application Package. On satisfactorily completing each check it automatically extinguishes the relevant control LED. It then continues with the next check until finally only the **Active** LED remains lit, indicating that the test sequence is completed and that the Recorder has returned to normal operating status.

Fault Indication:

Provided that the 2313 is functioning correctly, the entire test sequence takes approximately 75 seconds to carry out. If, however, a fault is detected then the test sequence will be permanently interrupted. At the same time the relevant control LED for the test plus those yet to be completed will flash, warning that a fault is present.

Where Self-Test is automatically interrupted and only the **Entering** and **Control** LEDs remain extinguished, then it is likely that only the Application Package is at fault. To check whether this is the case, reactivate Self-Test with another Package fitted. For repair, please contact your local B&K service representative. Under no circumstances should repair be attempted by persons not qualified in the service of electronic equipment.

3.9. USE OF OPERATING SET-UPS

Following installation of an Application Package BZ 7005 and a roll of Recording Paper QP 4690, one may proceed directly with operation as described in Chapter 4. However, to make full use of the complete range of documentation, storage and measurement functions available with BZ 7005, plus ensure correct read out of date, time etc., it is necessary to develop a basic understanding of the **Set-Up** mode of the Recorder.

Set-Up Mode and Levels:

The **Set-Up** mode is selected using the key of the same name in the bottom row of pushkeys of the Recorder. As indicated in Fig.3.7 it provides access to the "Select Set-Up", "Set Function", "Set Parameter" and "Set Clock" levels of the Recorder, the use of which are briefly discussed here and in more detail in the following sections.

Select Set-Up Level:

With the "Select Set-Up" level any one of four Operating Set-Ups numbered from 0 to 3 may be chosen. Each Set-Up is furnished with the functions and parameters listed in

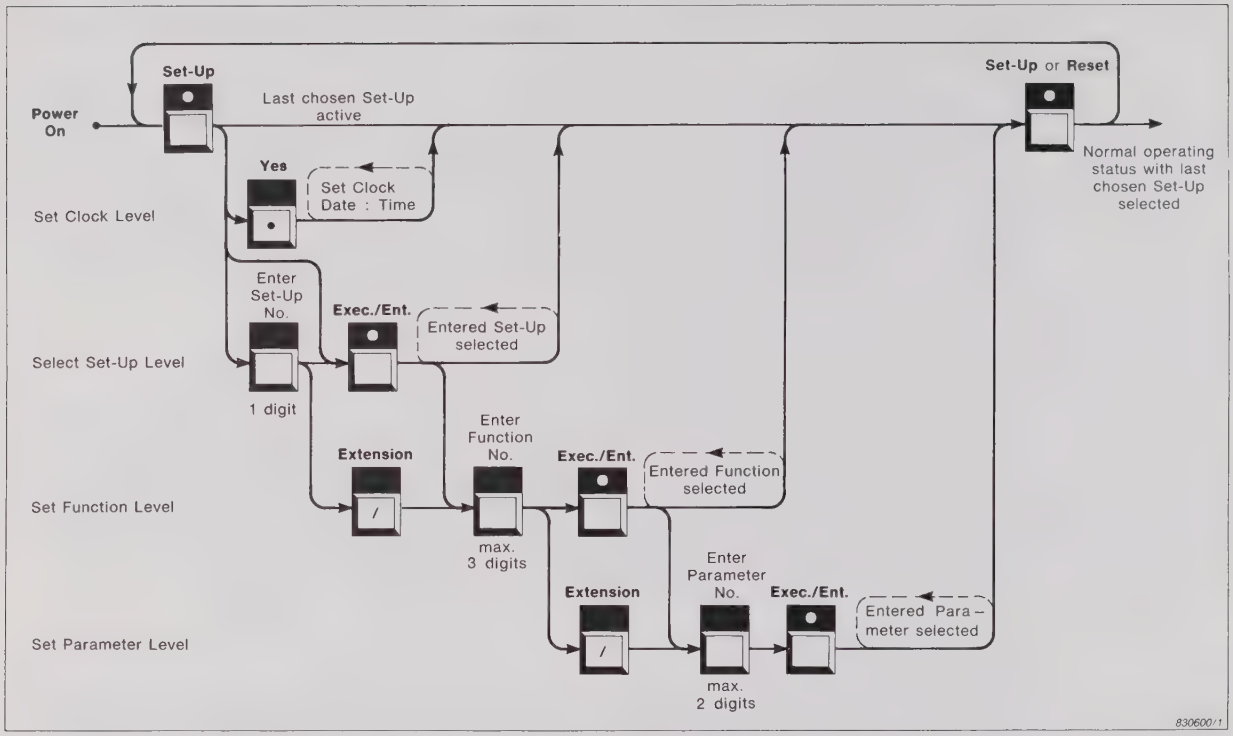


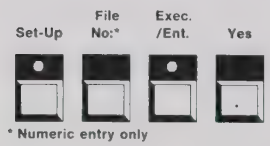
Fig. 3.7. **Set-Up** *mode key push sequences for selecting the Set Clock, Select Operating Set-Up, Set Function and Parameter levels of the 2313*

Fig. 3.8 which are individually numbered to permit access via the front panel pushkeys of the Recorder. Whereas the parameter values and units of Set-Up No: 0 are fixed, those of Set-Ups No: 1 to 3 may be changed by the user to suit individual application requirements. The range of values and units which may be set depends on the particular function to which the parameters belong and are specified in sections 4.2 to 4.5 respectively.

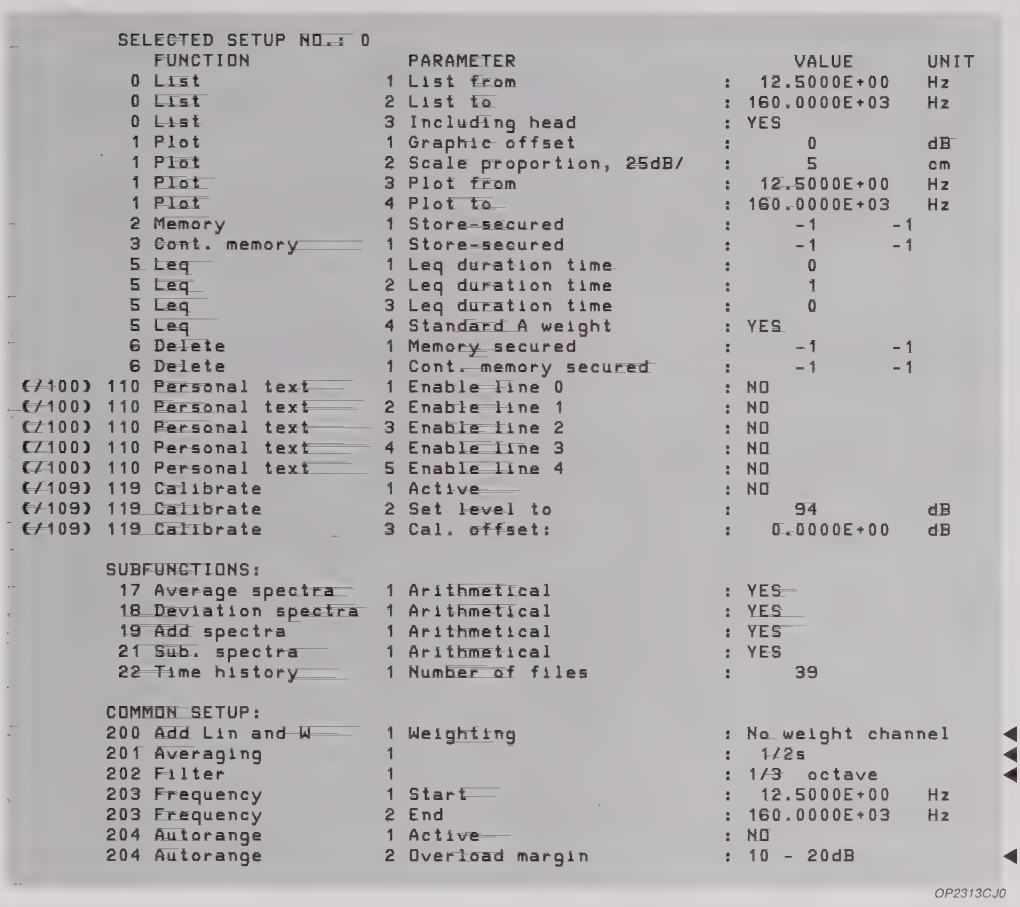
Function and Parameter Lists:

To obtain a complete list of functions available with Application Package BZ 7005, enter the following pushkey command:

Similarly, to obtain a complete function plus parameter list for any particular Operating Set-Up of BZ 7005, enter the following:



* Numeric entry only



```
        SELECTED SETUP NO.: 0
           FUNCTION                PARAMETER                        VALUE       UNIT
            0 List                 1 List from                :  12.5000E+00    Hz
            0 List                 2 List to                  : 160.0000E+03    Hz
            0 List                 3 Including head           : YES
            1 Plot                 1 Graphic offset           :       0         dB
            1 Plot                 2 Scale proportion, 25dB/  :       5         cm
            1 Plot                 3 Plot from                :  12.5000E+00    Hz
            1 Plot                 4 Plot to                  : 160.0000E+03    Hz
            2 Memory               1 Store-secured            :      -1        -1
            3 Cont. memory         1 Store-secured            :      -1        -1
            5 Leq                  1 Leq duration time        :       0
            5 Leq                  2 Leq duration time        :       1
            5 Leq                  3 Leq duration time        :       0
            5 Leq                  4 Standard A weight        : YES
            6 Delete               1 Memory secured           :      -1        -1
            6 Delete               1 Cont. memory secured     :      -1        -1
(/100)  110 Personal text          1 Enable line 0            : NO
(/100)  110 Personal text          2 Enable line 1            : NO
(/100)  110 Personal text          3 Enable line 2            : NO
(/100)  110 Personal text          4 Enable line 3            : NO
(/100)  110 Personal text          5 Enable line 4            : NO
(/109)  119 Calibrate              1 Active                   : NO
(/109)  119 Calibrate              2 Set level to             :      94         dB
(/109)  119 Calibrate              3 Cal. offset:             :   0.0000E+00    dB

        SUBFUNCTIONS:
           17 Average spectra      1 Arithmetical             : YES
           18 Deviation spectra    1 Arithmetical             : YES
           19 Add spectra          1 Arithmetical             : YES
           21 Sub. spectra         1 Arithmetical             : YES
           22 Time history         1 Number of files          :      39

        COMMON SETUP:
        200 Add Lin and W          1 Weighting                : No weight channel  ◀
        201 Averaging              1                          :  1/2s              ◀
        202 Filter                 1                          : 1/3  octave        ◀
        203 Frequency              1 Start                    :  12.5000E+00    Hz
        203 Frequency              2 End                      : 160.0000E+03    Hz
        204 Autorange              1 Active                   : NO
        204 Autorange              2 Overload margin          : 10 - 20dB          ◀
```

OP2313CJ0

Fig. 3.8. Functions and Parameters available with Operating Set-Up No: 0 (i.e. Default Set-Up) of Application Package BZ 7005. ◀ denotes which parameter values of Operating Set-Ups No: 1, 2 and 3 may be stepped using the **Yes** *key. Those not including ◀ accept numerical data (or logic* **Yes** *or* **No***). See section 3.9.4*

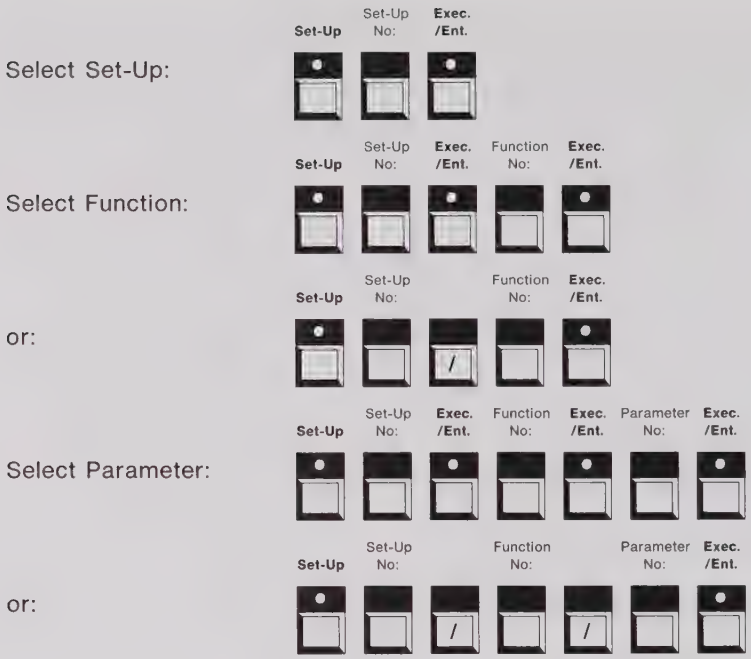
Set-Up Storage and Default Condition:

The individual Set-Ups are stored in the continuous memory of the Recorder and therefore are not affected by disconnecting mains power to the apparatus. If, however, another Application Package is inserted or the charge state of the internal Ni-Cd battery is allowed to fall below that required to power the continuous memory, then Set-Ups No: 1 to 3 will be automatically reset to the corresponding values of the Default Set-Up (i.e. Operating Set-Up No: 0). Also Operating Set-Up No: 1 will be automatically selected when first powering the instrument, instead of the set-up last chosen during previous use.

Basic Pushkey Commands:

The basic commands for selecting the various Set-Up mode levels, are as follows:

Select Clock:



further details of which are given in the following sections. If at any stage there is doubt about which Set-Up, Function or Parameter has been entered, or as to which values and units may be entered, press the **Help** key.

3.9.1. Set Clock

For a correct record of date and time at the top of each readout presented by the 2313, the built-in clock of the Recorder must be properly set. This is accomplished as described below and employs the key push sequence shown in Fig. 3.9.

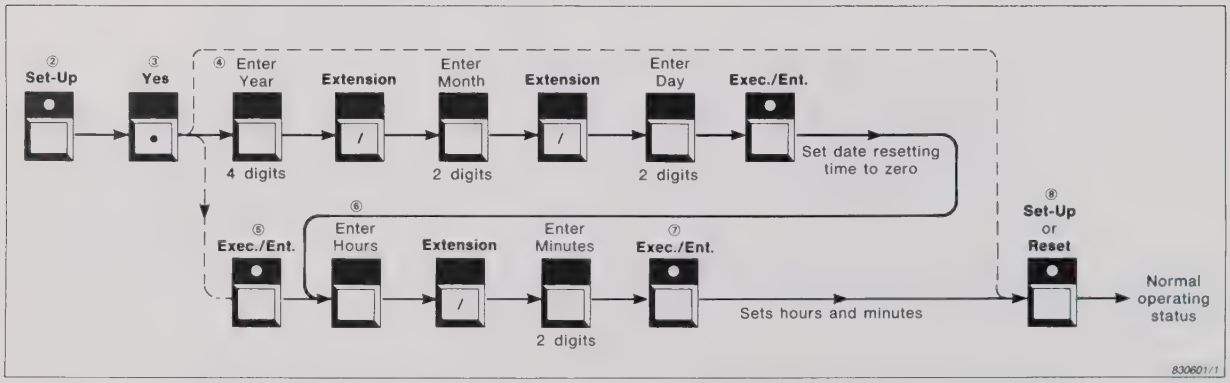


Fig. 3.9. **Set-Up** *mode key push sequence for setting date and time with the 2313*

1. Select **Power On**. Either the **Active** or **Entering** LED will light, and the date and time set with the internal clock printed, e.g.

```
DATE: 1984-07-01      TIME: 8:30:16
```

If `CONTINUOUS MEMORY AND CLOCK CLEARED` and/or `DATE: 9999-01-01` is printed, check that the internal Ni-Cd battery for the continuous memory is connected before proceeding with step 2. See section 3.4.

2. Press **Set-Up** to activate the Set-Up mode plus print the identity of the particular operating set-up selected. At the same time the **Set-Up** and **Entering** LEDs will light and, if previously lit, the **Active** LED extinguished.

```
Setup mode, active setup no: 1
```

3. Press **Yes** to activate the set clock mode, as well as print the date and time currently set.

```
Date: 1984-07-01      Time: 8:33:12    Enter Date
```

If both the date and time are correct, go to step 8 to return the 2313 to its initial operating status.

If only the date is correct, press **Exec./Ent.** and go to step 6 to enter the correct time.

4. For entry of the correct date, key-in **[YEAR] [/] [MONTH] [/] [DAY]** in turn. e.g.

To correct a false entry, press **Clear Entry** to delete, and re-enter the **[YEAR] [/] [MONTH] [/] [DAY]**.

5. Press **Exec./Ent.** to set the clock to the entered date and reset the time to zero.

```
Date: 1984-07-12      Time: 00:00:00    Enter time
```

6. To enter the correct time, key-in **[HOURS] [/]** and **[MINUTES]** one minute ahead of actual time. e.g.

To correct a false entry, press **Clear Entry** to delete, and re-enter **[HOURS] [/] [MINUTES]**.

7. Wait until the actual time corresponds to the value entered and press **Exec./Ent.** to set the clock to the correct time.

```
Date: 1984-07-12      Time: 10:45:00   Enter date
```

If the time set is not quite correct, press **Exec./Ent.** one more time and return to step 6.

8. Once the date and time are accurately set, press **Set-Up** to return the 2313 to normal standby status. The **Set-Up** LED should be extinguished and either the **Active** or **Entering** LEDs relit.

3.9.2. Select Set-Up

The "Select Set-Up Level" of the **Set-Up** mode permits selection of a suitable Operating Set-Up for documenting, storage and processing measurements. In addition it may be used for listing and setting one or more complete set-ups to default. The particular key push sequence employed is as described below and is illustrated in Fig.3.10.

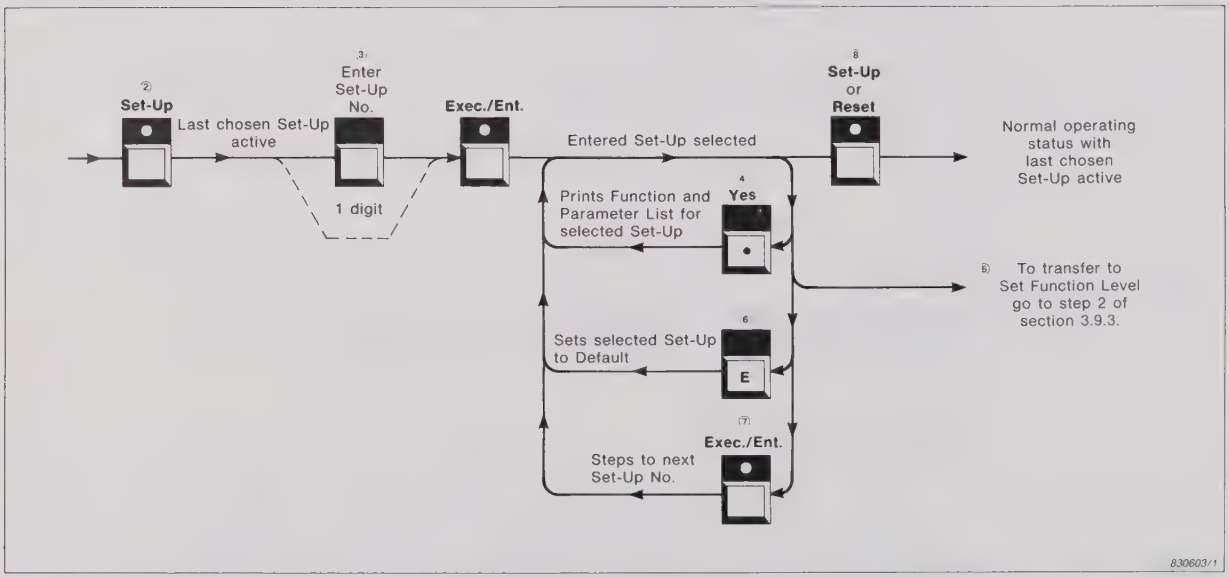


Fig. 3.10. **Set-Up** *mode key push sequence for selecting and listing Operating Set-Ups and setting them to default*

1. Select **Power On**. Either the **Active** or **Entering** LED will light, and the date and time set with the internal clock printed, e.g.

```
DATE: 1984-07-12      TIME: 10:48:16
```

If `CONTINUOUS MEMORY AND CLOCK CLEARED` and/or `DATE: 9999 -01-01` is printed, check that the internal Ni-Cd battery for the continuous memory is connected before proceeding with step 2. See section 3.4.

2. Press **Set-Up** to activate the Set-Up mode plus print the identity of the particular operating set-up selected. At the same time the **Set-Up** and **Entering** LEDs will light and, if previously lit, the **Active** LED extinguished.

```
Setup mode, active setup no: 1
```

3. Enter the number **[0, 1, 2 or 3]** of the particular set-up desired for operation and press **Exec./Ent.** to select the set-up. Alternatively, if the desired set-up is already active, press **Ent./Ent.** only. The identity of the set-up will be printed.

```
SELECTED SETUP NO: 2
```

Steps 4 to 8 may be carried out at the users discretion.

4. For a complete list of the operating functions, parameters and values set with the chosen set-up (see Fig. 3.8), press **Yes**.

5. To set one or more of the operating functions of the set-up to default or alter the parameters values of a particular function, go to step 2 of section 3.9.3 and 3.9.4 respectively.

6. To set the entire set-up to the default values set with the DEFAULT SET–UP NO: 0, press **[E]**. The following is printed:

```
Selected setup changed to default
```

7. If another set-up is preferred for operation or must be set to default, use the **Exec./Ent.** pushkey to step through each set-up in turn, until the required set-up is selected.

```
SELECTED SETUP NO: 1
SELECTED SETUP NO: 0
SELECTED SETUP NO: 3
```

8. To return the 2313 to normal standby status with the last chosen set-up selected, press **Set-Up** or **Reset**. The **Set-Up** LED should be extinguished and either the **Active** or **Entering** LED relit.

3.9.3. Set Function

The "Set Function Level" of the **Set-Up** mode is useful for listing and setting one or more complete control functions of the different Operating Set-Ups to default. The appropriate key push sequence employed is as described below and is shown in Fig.3.11.

1. Press the **Set-Up** pushkey and enter the number **[0 to 3]** of the particular set-up required for operation, e.g.

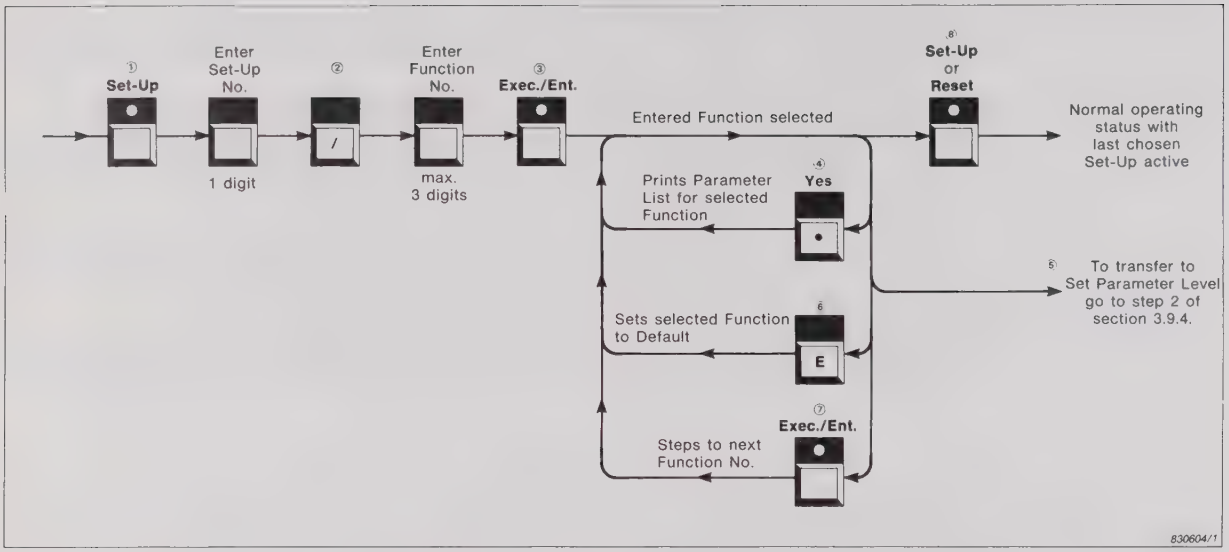


Fig. 3.11. **Set-Up** *mode key push sequence for selecting and listing individual Functions of the Operating Set-Ups, plus setting them to default*

2. Press **Extension[/]** and enter the number **[1 to 204]** of the particular operating function of interest, e.g.

To correct a false entry, press **Clear Entry** to delete, and re-enter the **[Set-Up Number] [/] [Function Number]**.

Note: If the required set-up has already been selected as in section 3.9.2, then only the **[Function Number]** should be entered.

3. Press **Exec./Ent.** to select the entered Set-Up and Function, plus print their identity.

```
SELECTED SETUP NO: 1
2 Memory
```

Steps 4 to 8 may be carried out at the users discretion.

4. For a list of the parameter values set with the selected function, press **Yes**.

```
SELECTED SETUP NO.: 1

  FUNCTION          PARAMETER                    VALUE      UNIT
5 Leq          1 Leq duration time          :      0          h
5 Leq          2 Leq duration time          :      1          m
5 Leq          3 Leq duration time          :      0          s
5 Leq          4 Standard A weight          : YES
```

5. To alter one or more of the parameter values of the function, go to step 2 of section 3.9.4.

6. To set the function to the default values set with the corresponding function of the DEFAULT SET–UP NO: 0, press **[E]**. The following is printed:

```
Selected function changed to default
```

7. If another function must be set to default, use the **Exec./Ent.** pushkey to step through each function in turn, until the required function is selected.

```
19 Add spectra
18 Deviation spectra
17 Average spectra
 6 Delete
```

8. To return the 2313 to normal operation with the above chosen set-up selected, press **Set-Up** or **Reset**. The **Set-Up** LED should be extinguished and either the **Active** or **Entering** LED relit.

3.9.4 Set Parameter and Parameter Value(s)

The "Set Parameter Level" of the **Set-Up** mode is used for selection and alteration of individual control function parameters within the Operating Set-Ups. The values and units to which the parameters may be individually set, depend on the particular control function to which they belong and are as specified in sections 4.2 to 4.5.

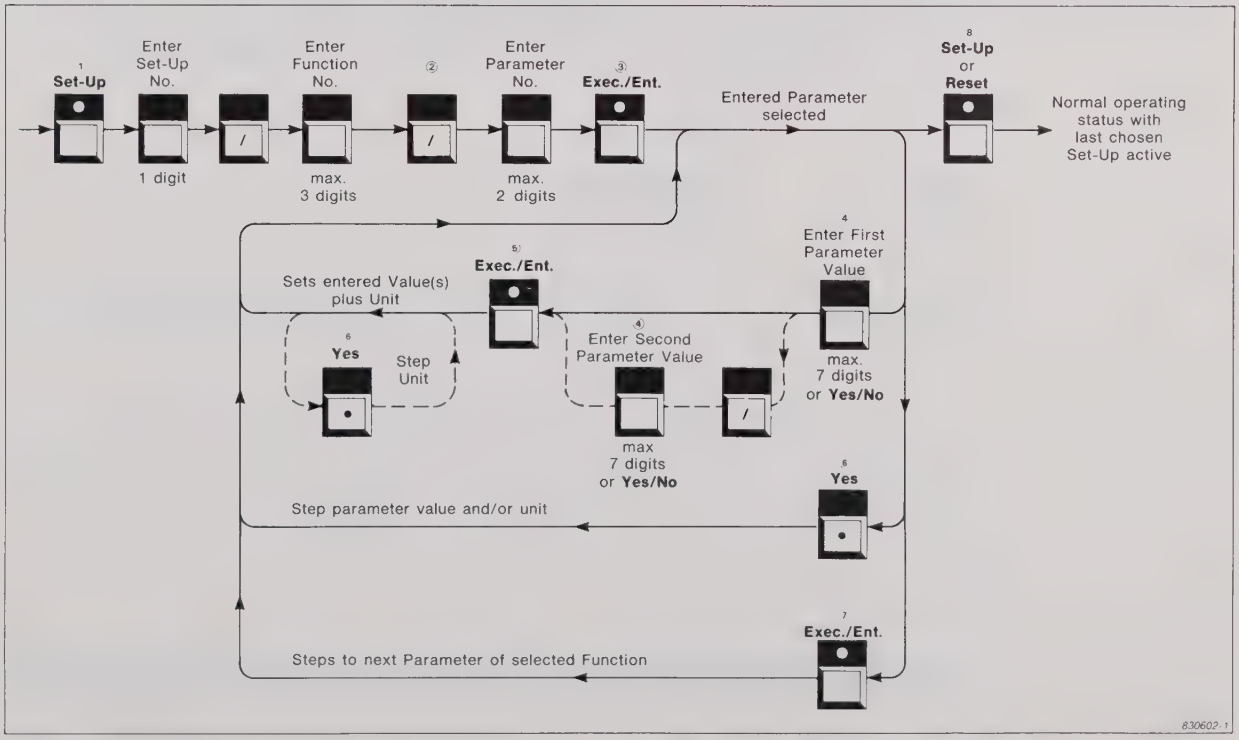
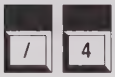


Fig. 3.12. **Set-Up** *mode key push sequence for selecting Operating Set-Ups Parameters, plus changing individual parameter values and units*

1. Press the **Set-Up** pushkey and enter the **[Set-Up Number] [/] [Function Number]** of interest. e.g.

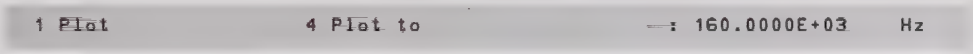
2. Press **Extension[/]** and enter the number **[1 to 5]** of the particular parameter of interest, e.g.



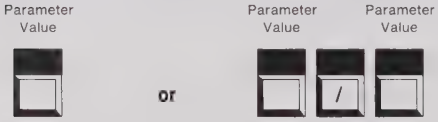
To correct a false entry, press **Clear Entry** to delete, and re-enter the **[Set-Up Number] [/] [Function Number] [/] [Parameter Number]**.

Note: If the required set-up and function have already been selected as in section 3.9.3, then only the **[Parameter Number]** should be entered.

3. Press **Exec./Ent.** to select the entered Set-Up, Function and Parameter, plus print their identity.



4. To alter the parameter value, enter the new value (max. 7 digits for numerical entries in exponential form e.g. **125000**, **125.0000E03** or **125E3**., or logic **Yes**, **No** where pertinent). With parameters having two separate values, enter **Extension[/]** after the first value to permit entry of the second.



If unsure of which value to enter, press **Help** for a printout of acceptable values (i.e. Parameter Value Check) plus details of current entry status. Alternatively, refer to sections 4.2 to 4.5 for the particular function selected.

To correct a false entry, press **Clear Entry** to delete, and re-enter the correct value.

Note: Certain parameter values included in the Operating Setups are step selectable. These are denoted by an arrow in Fig. 3.8, and may be stepped using the **Yes** key as discussed in item 6 of this section.

5. Press **Exec./Ent.** to set the value(s) entered, plus obtain a print out confirming the value(s) set:

If an incorrect value is entered, an error warning plus parameter value check will be printed, e.g.

```
Parameter value not allowed                                    ERROR NO: 6

PARAMETER VALUE CHECK:
        2.000000E+00 < value <  1.600000E+5
```

6. To change a stepped parameter value (denoted by an arrow in Fig. 3.8), repeatedly press **Yes** until the required setting is printed, e.g.

```
201 Averaging          1                          :    4s
201 Averaging          1                          :    2s
201 Averaging          1                          :    1s
201 Averaging          1                          :  1/2s
```

7. To step to another parameter of the selected function, ready for entry of new values as in steps 4 to 6, repeatedly press **Exec./Ent.** until the appropriate parameter is printed.

```
5 Leq                  4 Standard A weight        : YES
5 Leq                  3 Leq duration time        :    0        s
5 Leq                  2 Leq duration time        :    1        m
5 Leq                  1 Leq duration time        :    0        h
```

8. To select another function and/or parameter within the same set-up, first return to normal operation and then repeat the above procedure.

   To return to normal operation with the above set-up and parameter values selected, press **Set-Up** or **Reset**. The **Set-Up** LED should be extinguished and either the **Active** or **Entering** LED relit.

4. USE WITH BAND PASS FILTER TYPE 1617 AND MEASURING AMPLIFIER TYPE 2636

4.1. BASIC ANALYSIS AND RECORDING SET-UP

The basic instrument arrangement for use of the Graphics Recorder Type 2313 together with Measuring Amplifier Type 2636 and Band Pass Filter Type 1617, is shown in Fig. 4.1. Preparation of the instruments ready for documentation, storage and processing of octave and third octave frequency analyses as well as other measurements is as described below. If desired a Digital Cassette Recorder Type 7400 may be included in the arrangement for recording and playback of measurements for additional processing at a later date.

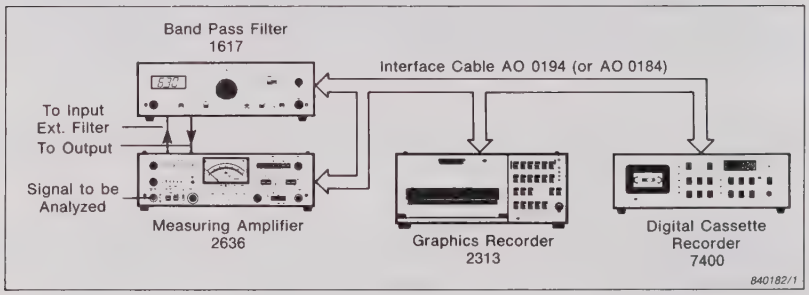


Fig. 4.1. Use of the 2313 Graphics Recorder with the 2636 Measuring Amplifier, 1617 Band Pass Filter and 7400 Digital Cassette Recorder

1. Fit the Graphics Recorder with an Application Package BZ 7005, Control Function Overlay SA 0305 and roll of Recording Paper QP 4690. See Chapter 3.

2. Interconnect the instrumentation as indicated in Fig. 4.1. To facilitate use of short connection cables mount the Band Pass Filter on top of the Measuring Amplifier.

3. Check that the "System Controller Active" mode and appropriate "Metric" or "English" chart length are selected with the **Address Switch** pairs **8** and **7** on the rear panel of the Graphics Recorder (see Fig.4.2).

   Similarly, to permit communication with the other instruments in the arrangement, set their interface switches as follows:

Type 1617	**Listen Address:**	"00011"
	PPR Selector:	"10000000"
Type 2636	**Address Switch:**	"00000100"
	Interface key:	"Front"
Type 7400	**Multiswitch:**	"100111"
	Interface Mode:	"IEC"

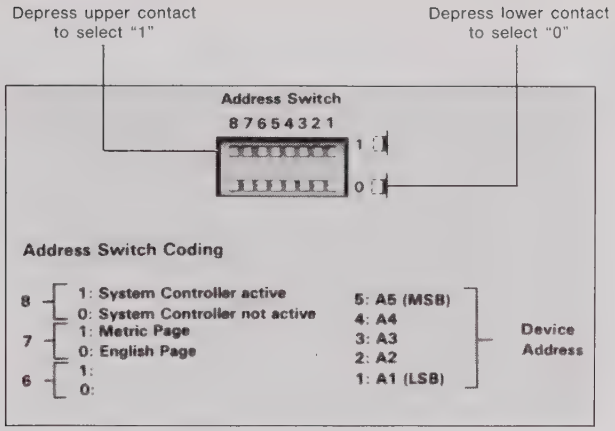


Fig. 4.2. **Address Switch** *on the rear panel of the 2313*

4. Select **Power On**, and press the **Reset** key on the Graphics Recorder. The Recorder will then print the date and time set with its internal clock, plus light the **Active** LED indicating that it is ready for use as a system controller.

   Note: If `CONTINUOUS MEMORY AND CLOCK CLEARED` and/or `DATE: 9999-01-01` is printed, check that the internal Ni-Cd battery for the memory of the Graphics Recorder is connected before proceeding with step 5. See section 3.4.

5. Using the **Set-Up** key of the Recorder, activate the Set-Up mode to set the correct date and time with the built-in clock, plus select the particular Operating Set-Up of interest for processing measurements. See sections 3.9.1 and 3.9.2.

   Note: When first using the 2313 it is recommended that the particular Operating Set-up selected is set to default. This will help simplify operation whilst getting to know the 2313 and its use with the other instruments employed.

6. Fit the Measuring Amplifier with a meter scale appropriate for the particular measurement to be carried out, and calibrate the instrument as described in its Instruction Manual. Once calibrated return the **Input and Output Section Gain** knobs of the instrument to their extreme clockwise position ready for measurements.

7. Set the "Ext" **Filter** key of the Measuring Amplifier to its upper position, plus the **Selectivity** and **Range** keys of the Band Pass Filter to "1/3 octave" and "Lin" respectively. This will enable the Measuring Amplifier to be used for monitoring the input signal and its **Input** and **Output Section Gain** to be set to obtain a suitable meter level indication prior to activating the Graphics Recorder for documenting, storage or processing of measurement.

The instrument arrangement is now ready for use. To commence measurement, apply the signal to be measured to the "Direct" or "Preamp." **Input** of the Measuring Amplifier and adjust the **Input Section Gain and Output Section Gain** knobs of the instrument to obtain an suitable meter deflection without overload. Measurement may then be started by entering one of the following commands with the aid of the front pushkeys of the Graphics Recorder.

Activates 1/3 octave measurement, plus list results

Activates 1/3 octave measurement, plus plots results.

Activates Leq measurement, plus lists result

Once activated manual operation of the Band Pass Filter and/or Measuring Amplifier is automatically disabled and control of the instrument arrangement passed to the Graphics Recorder. The Recorder then senses and automatically selects the relevant control settings for the measurement which when using an Operating Set-Up which has been set to default, are set as follows:

Octave and Third Octave Measurements:

For these measurements the front panel controls of the Measuring Amplifier are set to:

Input:	"Direct" or "Preamp." as manually set
Ref:	"Off" or "50 mV RMS" as manually set
▶ **Input Section Gain:**	As manually set
▶ **Output Section Gain:**	As manually set
Filters:	"Ext", plus "22,4 Hz" high-pass and/or "22,4 kHz" low-pass depending on Band Pass Filter centre frequency
Detector Function:	"0,1 s"
Detector Output:	"Norm." and "Log. 60 dB"
Peak:	Disabled

and the controls of the Band Pass Filter to:

▶ **Bandwidth:**	"1/3 Octave"
▶ **Record Step:**	"1/3 Octave"
Range:	"2 Hz to 160 kHz"
▶ **Selected Filter:**	"12,5 Hz"
Filter Control Mode:	"Recorder" – "Remote"
Averaging Control:	Disabled

As indicated the Graphics Recorder automatically selects the 60 dB Log – RMS measurement mode of the Measuring Amplifier plus connects it in series with the Band Pass Filter which is set to its 1/3 octave mode with start frequency of 12,5 Hz selected. If desired, certain settings may by altered using the Common Functions contained in the

Operating Set-Up (see section 4.5). These settings are marked by a ▶ symbol in the above, and enable 1/1 octave bandwidth, different start and end frequencies, averaging times, confidence level, etc. to be selected prior to starting measurements. Also, Auto-**Calibrate** as well as **Auto-Ranging** functions may be chosen to check the calibration and optimize the dynamic range of the measuring arrangement. See sections 4.4.10 and 4.5.5., respectively.

Following selection of the appropriate control settings, the Graphics Recorder waits four times the period of the particular filter centre frequency selected to account for signal response time of the filter. It then samples the level of the filtered signal at 30 ms intervals and determines its RMS level in accordance with the Averaging Time or Confidence Level specified in the Operating Set-Ups (0,5 s averaging time for default condition). Once correctly averaged the Graphic Recorder stores the RMS level in its work memory and automatically switches the Band Pass Filter to the next filter centre frequency ready for the next measurement.

The above measurement process is then repeated until measurement with the 160 kHz centre frequency band is completed, whereupon the Graphics Recorder generates a hard copy output of the measurement either in the form of a graphic plot or as complete alphanummeric listing similar to those shown in sections 4.2.1 and 4.2.2.

Leq Measurements:

For measurement of Leq (i.e. the equivalent steady-state sound level of a fluctuating noise or sound input) the Band Pass Filter is not needed. It is therefore automatically switched out of the arrangement leaving only the Measuring Amplifier connected which is set as follows:

Input:	"Direct" or "Preamp." as manually set
Ref:	"Off" or "50 mV RMS" as manually set
▶ **Input Section Gain:**	As manually set
▶ **Output Section Gain:**	As manually set
▶ **Filters:**	"A"-weight, plus "22,4 Hz" high-pass, "22,4 kHz" low-pass
▶ **Detector Function:**	"Fast"
Detector Output:	"Norm." and "Log. 60 dB"
Peak:	Disabled

Having automatically selected the above control settings the Graphics Recorder samples the "A"-weighted RMS "Fast" level of the measured signal at 30 ms intervals. It then averages the samples over a 60 second measurement period to determine the equivalent continuous or steady-state sound pressure level which has the same total energy as the real fluctuating sound measured over the same period. Measurement is as prescribed in ISO 1996 and DIN 45 644, and is based on the equal energy (3 dB amplitude/time doubling) principle:

$$L_{eq} = 10 \, \mathrm{Log}_{10} \frac{1}{T} \int_0^T \left(\frac{p(t)}{p_o} \right)^2 \, dt$$

where *Po* is the reference sound pressure (20μPa), *p(t)* is the time varying sound pressure and *T* is the time interval over which it is measured.

On completing measurement, the Graphics Recorder automatically prints the result and returns the instrument arrangement to standby ready for a new measurement to be activated via the pushkeys of the Recorder.

If required the exact time the measurement is to be started may be keyed in with the **Leq** function. Also, different frequency and time weightings may be chosen, plus measurement periods ranging from 1s to almost 60 hours specified using the control parameters contained in the current Operating Set-Up (see section 4.2.6). Similarly, Auto-**Calibrate** and **Auto-ranging** functions may be chosen to check the calibration and optimize the dynamic range of the measuring arrangement. See sections 4.4.10 and 4.5.5.

4.2. FUNCTIONS – GENERAL GUIDE

The basic syntax for documenting, storing and processing of measurement data with the 2313 is the same regardless of which application package is employed. First the DESTINATION must be entered and then the SOURCE, e.g.

	DESTINATION	SOURCE	
	[List]	***[7400]***	**[Exec./Ent.]**
or	**[Plot]**	**[*Memory*] [/]** [file no.]	**[Exec./Ent.]**
or	**[7400]** [file no.]	**[/] [*Memory*] [/]** [file no.]	**[Exec./Ent.]**

Data Destination and Source:

In general, DESTINATIONS are described by the functions printed in plain text on the Control Function Overlay provided with the Application Package. Following entry of a function the **Active** LED is extinguished and the **Entering** LED is lit instead. This indicates that the 2313 is ready to receive information on the SOURCE which is described by the sub-functions printed in cursive text on the Overlay. Alternatively, numbers can be entered for specifying which memory or tape file a measurement is to be sent to, provided that this is followed by **Extension [/]** to permit entry of the SOURCE. If no SOURCE is specified the 2636 plus 1617 will be automatically chosen for 1/3 or 1/1 octave band measurements, while if no memory or tape file number is specified for output of a stored measurement, memory file 0 or the currently selected tape file will be selected.

Repetition of Measurement Task:

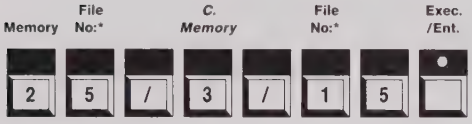
Once a specific documentation, storage or measurement task has been executed, and the **Active LED** of the 2313 is relit, the same task can be repeated simply by pressing the **Exec./Ent.** pushkey. At the same time this will automatically update the memory or tape file locations of the DESTINATION and SOURCE so that next file is chosen. Thus a whole series of separate measurements may be documented or stored in successive memory or tape files without having to re-enter the entire pushkey sequence each time.

Help Information:

If a false entry is made, it may be corrected prior to execution simply by pressing the **Clear Entry** pushkey and entering the entire sequence afresh. Similarly, execution of an unwanted function or task can be terminated by activating the **Reset** key. When in doubt about the particular function, sub-function and file numbers entered, the current status of the entry can be printed by activating **Help**. e.g.

```
Selected overlay function:   2
Entered value :      5              / 3              / 15
```

which corresponds to the following pushkey command:



Stores measurement in V. Memory file 5 from C. Memory file 15

4.2.1. List [0] – Function No: 0

Utilizing **List**, Leq measurements and 1/3 or 1/1 octave analyses may be performed and the results documented as shown in Figs. 4.3 and 4.4. Also measurements which have been subjected to statistical processing by the 2313 may be documented, plus those which have been stored with the 2313 or on tape with the 7400.

```
B K   Date:  1984-11-28
      Time:    09:07:19
2636                              2636 SETTINGS

Spectrum                          Averaging time:          3s
                                  Input gain:          20.0dB
                                  Filter bandw. 1/1   octave
GEAR BOX NOISE                    Output gain:         20.0dB
Comments:_____________
DAMPING                           **       OVERLOAD        **
__________________________        Max. level:          88.7dB

CHANNEL NO.   FREQ. Hz     LEVEL dB

      6            4.0         67.4
      9            8.0         64.5
     12           16.0         58.5
     15           31.5         58.7
     18           63.0         67.6
     21          125.0         71.8
     24          250.0         61.0
     27          500.0         66.7
     30         1000.0         74.9
     33         2000.0   MAX   88.7
     36         4000.0         85.8
     39         8000.0         79.3
     42        16000.0         70.9
```

850041

Fig. 4.3. Typical 1/1 octave listing of signal analyzed with the 1617 Band Pass Filter and 2636 Measuring Amplifier

```
B K   Date:  1984-11-29
      Time:    09:01:41
Leq measurement                   2636 SETTINGS
Measurement time: 0:01:00         A-weighting network
                                  Freq. range: 22Hz - 22kHz
OFFICE ENVIRONMENT                Detector function:   Fast
WITH DOCUMENT                     Input gain:          40.0dB
PRINTER OPERATING                 Output gain:          0.0dB
1 MINUTE
Max. level:          78.0dB

Leq =   75.5dB
```

850042

Fig. 4.4. Typical listing of Leq measurement performed with the 2636 Measuring Amplifier and 2313 Graphics Recorder

As indicated in Figs. 4.3 and 4.4 details on instrument control settings, personal text, plus the date and time of the particular readout are printed as part of the documentation heading. In addition, the maximum level is indicated and appropriate warnings included if the measuring arrangement is overloaded or the input level margin selected is exceeded.

Operating Set-Up Parameters:

The user accessible parameters controlling documentation produced by the **List** function have the parameter numbers and identities specified below. These are accessible with Operating Set-Ups No: 1, 2 and 3 of the 2313 and to suit different types of measurement may be used to alter the readout by assigning them the parameter values indicated.

```
SELECTED SETUP NO.: 0
   FUNCTION              PARAMETER                    VALUE        UNIT
 0-List                1-List from              :  12.5000E+00    Hz
 0-List                2-List to                :  160.0000E+03   Hz
 0-List                3 Including head         : YES
```

1–List from and **2–List to:** Accept any value between 2.000000E+00 and 1.600000E+05 (i.e. 2 Hz and 160 kHz) with default at 12.5000E+00 and 160.0000E (i.e. 12,5 Hz and 160 kHz) respectively. They define filter centre frequency range over which 1/3 and 1/1 octave measurements are listed. Entry of an exact centre frequency value is not necessary, as the 2313 automatically rounds it to the closest 1/3 or 1/1 octave band.

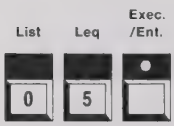
3–Including head: Accepts logic **Yes** or **No**, with **Yes** as default. It determines whether or not instrument control settings, comments and personal text etc., are used to head listed measurements. It has no effect on readout of date and time which are always printed to facilitate future reference.

For further details on the use of Operating Set-Ups, section 3.9 should be consulted.

Basic Pushkey Commands:

For activating 1/1 or 1/3 octave analysis or an Leq measurement plus listing results, the following pushkey sequences apply:

Lists 1/3 or 1/1 Octave Spectrum from 1617 and 2636



Lists Leq measurement from 2636

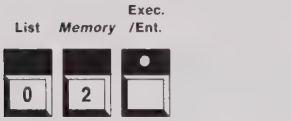
Once activated the 2313 selects the appropriate control settings on the Band Pass Filter and/or Measuring Amplifier and proceeds with the measurement as described in section 4.1. When measurements are completed a readout is generated and the **Exec./Ent.** LED is extinguished to indicate that the measuring arrangement has returned to standby and is ready for a new measurement to be performed.

The time taken to perform a measurement can be as little as 1 second or as great as 60 hours. It depends on the type of measurement, as well as the measurement period, analysis bandwidth, centre frequency range, averaging time, etc., selected with the control parameter in the current Operating Set-Up (see sections 4.2.6 and 4.5). For most types of measurements, however, the measurement time is between 1 and 2 minutes.

After a measurement is completed, a new one may be initiated simply by pressing the **Exec./Ent.** key. This will automatically recall and execute the previous pushkey command, thus enabling a second or third measurement to be performed without having to enter the entire pushkey command afresh. Alternatively, an extra copy of the previous measurement may be obtained by entering:

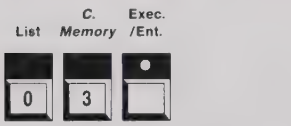
Recalls and lists previous measurement result from 2313 Last Memory

Besides documenting measurements from the Last Memory, those which have been stored using either the Volatile or Continuous Memory of the 2313 can be listed. The appropriate pushkey sequences for this purpose are illustrated below. Also given are sequences for listing measurements recorded on tape using the 2313 together with the 7400 Digital Cassette Recorder.



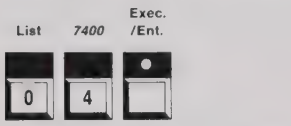
Lists measurement stored in V. Memory File 0

Lists measurement stored in V. Memory File Y

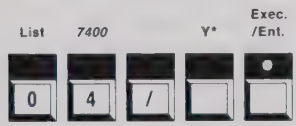


Lists measurement stored in C. Memory File 0

Lists measurement stored in C. Memory File Y



Lists measurement stored in currently selected 7400 Tape File



Lists measurement stored in 7400 Tape File Y

* Numeric entry only

where Y can be assigned any memory file number between 0 and 31 999 or tape file number between 1 and the highest file number allocated by the 7400.

Following each readout **List** can be reactivated simply by pressing the **Exec./Ent** push-key. This will list the measurement stored in the next file, thus making it possible to document a second or third stored measurement etc. without having to enter the entire pushkey sequence each time. Any attempt to access a non existent file will result in an appropriate error message being printed, plus return the 2313 to normal standby status. For listing subsequent files a new pushkey sequence must be entered afresh.

Use With Other Functions:

As indicated in Fig. 4.5 the 2313 may also be used to list measurements processed using the ***Average, Deviation, Time History, Add Spectra*** and ***Sub. Spectra*** sub-functions. These are discussed in later sections of this chapter which also include examples of the types of readout generated.

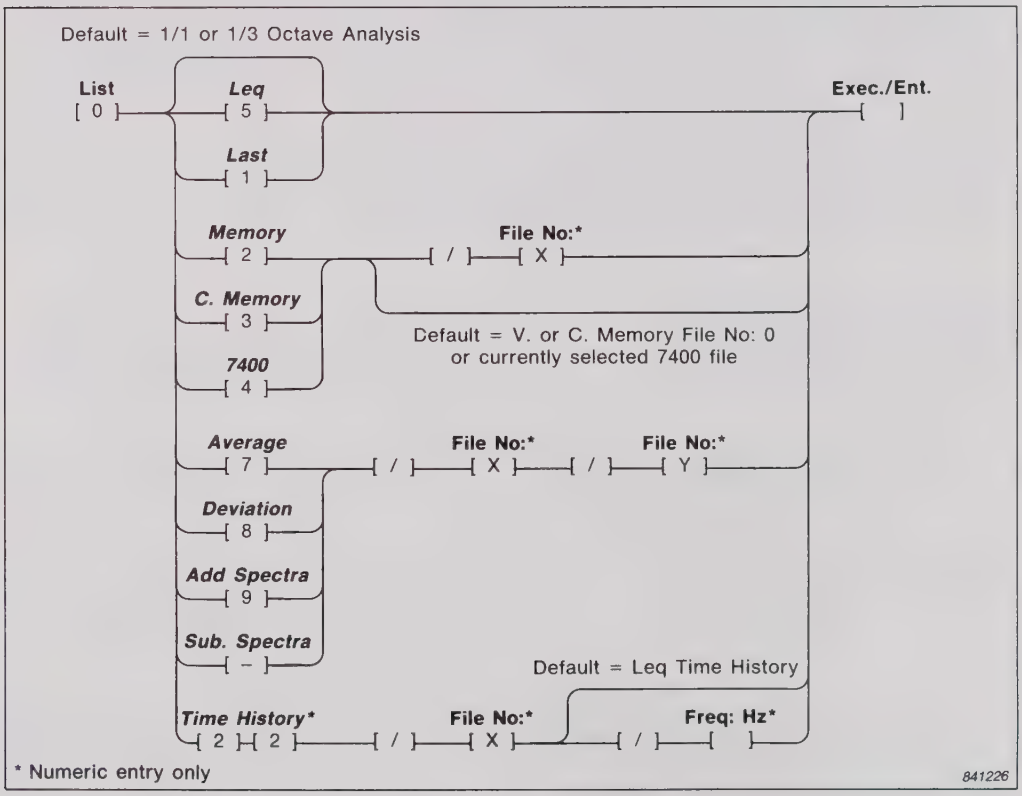


Fig. 4.5. Pushkey Sequence Chart – **List**

4.2.2. Plot [1] – Function No: 1

The **Plot** function generates fully annotated graphic plots of 1/3 or 1/1 octave measurements performed by the 2636 and 1617. In addition measurements stored or processed by the 2313 may be plotted, plus those which are stored on tape with the 7400. Unlike the **List** function, however, it cannot be used for documenting Leq measurements.

The type of documentation generated is similar to that shown in Fig. 4.6 and includes details on instrument control settings, plus the date and time of the particular readout. Also, space is available for entry of personal text and comments, and warnings are

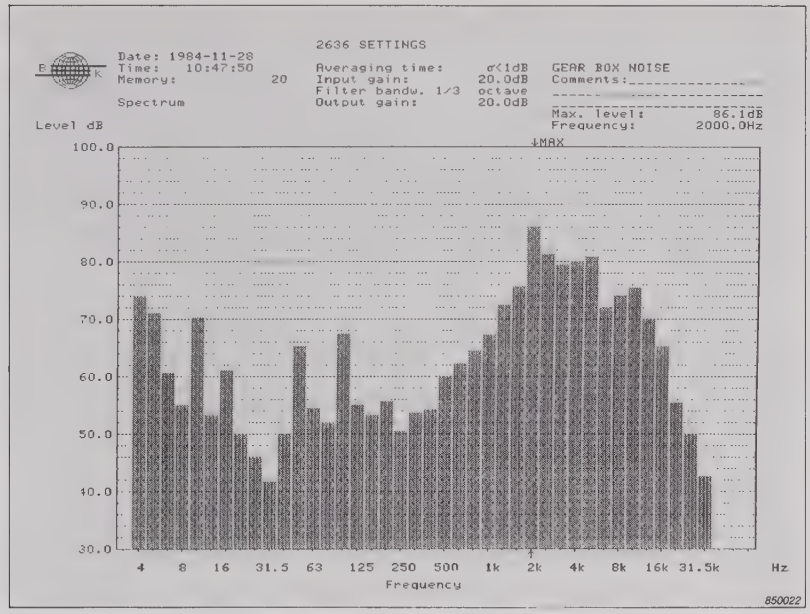


Fig. 4.6. Typical 1/3 octave plot of signal measured with the 1617 Band Pass Filter and 2636 Measuring Amplifier

printed if the measuring arrangement is overloaded or the input level margin selected is exceeded.

Operating Set-Up Parameters:

The user accessible parameters controlling documentation produced by the **Plot** function have the parameter numbers and identities specified below. These are accessible with Operating Set-Ups No: 1, 2 and 3 of the 2313 and to suit different types of measurement may be used to alter the readout by assigning them the parameter values indicated.

```
SELECTED SETUP NO.: 0
   FUNCTION              PARAMETER                    VALUE        UNIT
 1 Plot                1 Graphic offset          :      0           dB
 1 Plot                2 Scale proportion, 25dB/ :      5           cm
 1 Plot                3 Plot from               :  12.5000E+00     Hz
 1 Plot                4 Plot to                 : 160.0000E+03     Hz
```

1–Graphic offset: Accepts values between -50 and 50 dB in 5 dB increments, and on default is set to 0 dB. Is used to shift the vertical axes up or down so that measurements plotted with scale proportion of 25 dB/10 cm and 25 dB/20 cm can be properly documented without being clipped. For measurements plotted with a scale proportion of 25 dB/5 cm, use of the default value 0 dB is normally sufficient.

2–Scale proportion, 25 dB/: Accepts values of 5, 10 and 20 cm, with 5 cm as default. It sets the scale proportion of the vertical axes giving corresponding amplitude ranges of 70, 35 and 17,5 dB respectively.

3–Plot from and **4–Plot to:** Accept any value between 2.000000E+00 and 1.600000E+05 (i.e. 2 Hz and 160 kHz) with default at 12.5000E+00 and 160.0000E (i.e. 12,5 Hz and 160 kHz) respectively. They define filter centre frequency range over which measure-

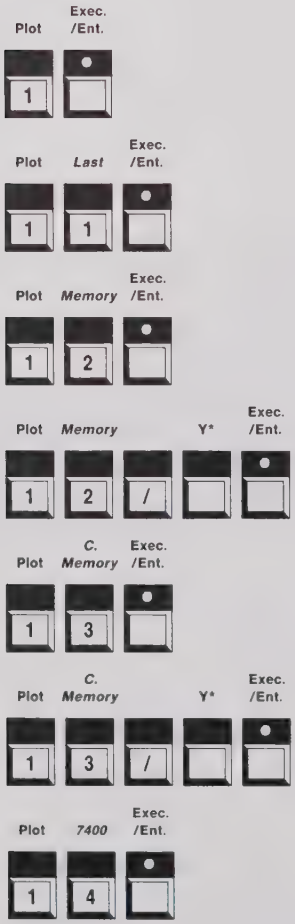
ments are plotted. Entry of an exact centre frequency value is not necessary, as the 2313 automatically rounds it to the closest 1/3 or 1/1 octave band.

Note: Whereas measurements may be made over a maximum of 50 1/3 octave bands covering centre frequencies from 2 Hz to 160 kHz, plots contain between 39 and 42 octave bands, starting from the **Plot from:** centre frequency band specified in the Operating Set-Up. Thus for readout of centre frequency bands up to 20 kHz, 40 kHz, 80 kHz and 160 kHz respectively, **Plot from:** must be set to 2 Hz, 4 Hz, 8 Hz and 12,5 Hz respectively.

Where it is required to document a measurement spanning more than 39 or 42 1/3 octave bands, the measurement may be recalled from the last memory. This enables an exact copy of the previous plot to be obtained or, if the **Plot from:** centre frequency is altered, enables the 1/3 octave bands not previously printed to be plotted.

Basic Pushkey Commands:

For plotting 1/3 or 1/1 octave measurement results generated by the 1617 and 2636, or measurement results stored with the 2313 or 7400, the following pushkey commands apply. These are very similar to those used for listing measurements and therefore section 4.2.1 should be consulted where a more detailed explanation is required.



Plots 1/3 or 1/1 Octave Spectrum from 1617 and 2636

Plots previous measurement result recalled from 2313 Last Memory

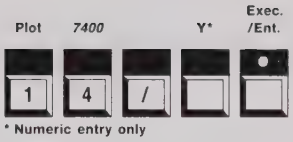
Plots measurement stored in V. Memory File 0

Plots measurement stored in V. Memory File Y

Plots measurement stored in C. Memory File 0

Plots measurement stored in C. Memory File Y

Plots measurement stored in currently selected 7400 Tape File



Plots measurement stored in 7400 Tape File Y

where Y can be assigned any memory file number between 0 and 31 999 or tape file number between 1 and the highest file number allocated by the 7400.

Use With Other Functions:

In addition to the above, **Plot** may be used with the ***Simultaneous, Average, Deviation, Time History, Add Spectra*** and ***Sub. Spectra*** sub-functions. The relevant pushkey sequences for this purpose are illustrated in Fig. 4.7 and are discussed in later sections of this chapter which also include examples of the types of readout obtained.

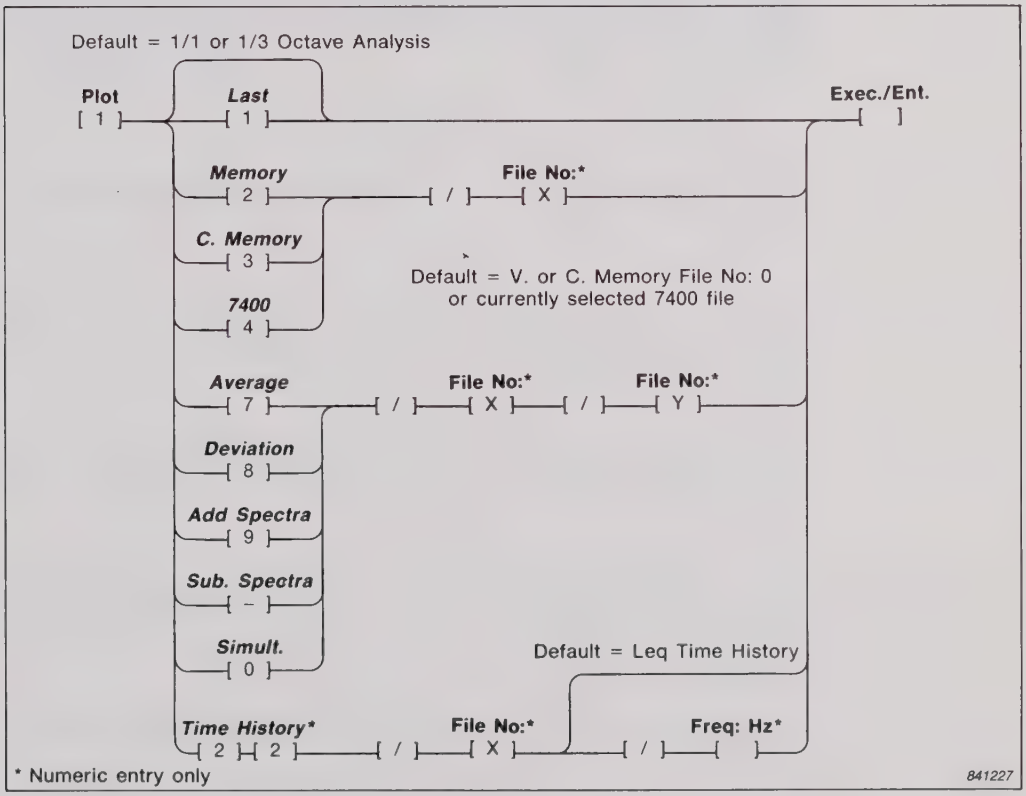


Fig. 4.7. Pushkey Sequence Chart – **Plot**

4.2.3. Move to Volatile Memory [2] – Function No: 2

Using the **Memory** function of the 2313, measurement results plus control setting information, can be stored for future use. These are filed in the volatile memory and therefore may be retained as long as the Recorder is powered from the mains supply. Not only can stored measurements be retained for documentation at a later time during current use, but they can also be read out to other digital equipment such as the 7400,

or they may be subjected to further processing by the 2313. The maximum number measurements which may be filed depends on the type of data processed and is as follows:

300 × 1/1 octave and Leq measurements, including 1/1 octave spectra processed with the Add, Subtract, Average and Deviation functions
or 228 × 1/3 octave measurements plus 1/3 spectra processed with the Add, Subtract, Average and Deviation functions
or 123 × Time History and Simultaneous Spectra

Operating Set-Up Parameters:

To help safeguard stored measurements, Operating Set-Ups No: 1, 2 and 3 are equipped with the following control parameters:

```
SELECTED SETUP NO.: 0
   FUNCTION              PARAMETER                    VALUE       UNIT
 2 Memory              1 Store-secured          :     -1     -1
 6 Delete              1 Memory secured         :     -1     -1
```

These accept values between 0 and 31999 and permit any group of consecutive volatile memory files to be store- or delete-secured simply by entering the numbers of the first and last files of the group to be protected. Also vacant files can be secured so that once a measurement has been stored in a vacant file, subsequent attempts to delete or store new data in the same file will be blocked by the Recorder.

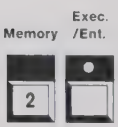
A particularly important point to note, is that files only remain secured whilst operating with the particular Operating Set-Up in which they are store- and delete- secured. Consequently for reliable protection of data, it is important that the same files secured in Set-Up No: 1, for example, also be secured in Set-Ups No: 2 and 3. Also care must be exercised if the Default Set-Up No: 0 is chosen, as it is not possible to secure stored data with this Set-Up. In this case it is recommended that the **Memory Menu** function of the Recorder be activated (see section 4.2.8). This itemizes which files are already occuppied by the four Operating Set-Ups as well as indicates whether they are store- or delete-secured.

If desired store- and delete-secured protection may be disabled, to permit new measurements to be stored in place of those no longer of interest. For this purpose a new set of parameter values may be keyed in at any time during operation, which leaves only those files containing important data secured. Where it is required to disable protection with all files, the default values of –1 to –1 should be entered.

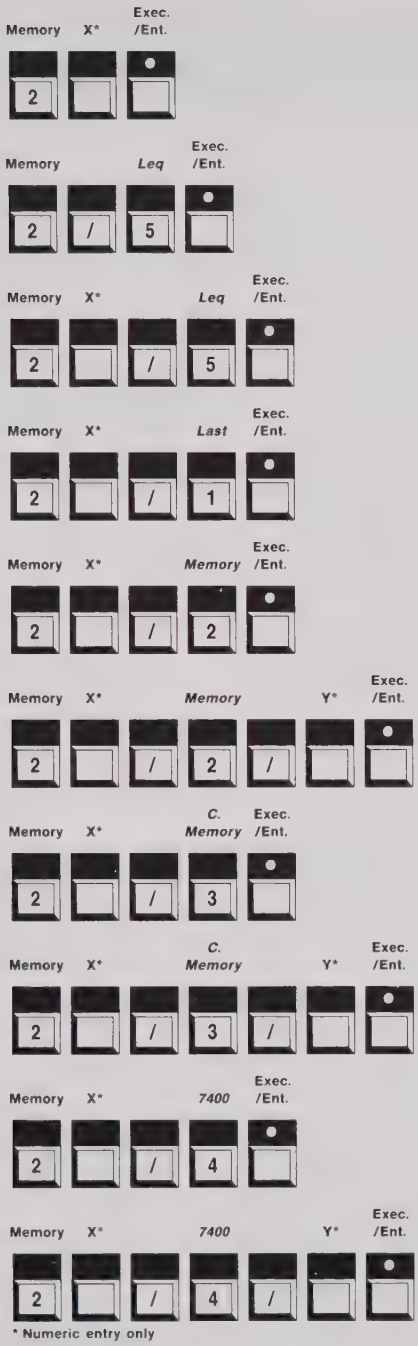
For further details on the use of Operating Set-Ups, section 3.9 should be consulted.

Basic Pushkey Commands:

For storing measurements in the volatile memory, the following pushkey sequences plus those shown in Fig. 4.8 apply:



Activates 1/3 or 1/1 octave measurement storing result in V. Memory File 0


Memory X* Exec. /Ent.
2
Memory Leq Exec. /Ent.
2 / 5
Memory X* Leq Exec. /Ent.
2 / 5
Memory X* Last Exec. /Ent.
2 / 1
Memory X* Memory Exec. /Ent.
2 / 2
Memory X* Memory Y* Exec. /Ent.
2 / 2 /
Memory X* C. Memory Exec. /Ent.
2 / 3
Memory X* C. Memory Y* Exec. /Ent.
2 / 3 /
Memory X* 7400 Exec. /Ent.
2 / 4
Memory X* 7400 Y* Exec. /Ent.
2 / 4 /
* Numeric entry only

Activates 1/3 or 1/1 octave measurement storing result in V. Memory File X

Activates Leq measurement storing result in V. Memory File 0

Activates Leq measurement storing result in V. Memory File X

Stores measurement in V. Memory File X from Last Memory

Stores measurement in V. Memory File X from V. Memory File 0

Stores measurement in V. Memory File X from V. Memory File Y

Stores measurement in V. Memory File X from C. Memory File 0

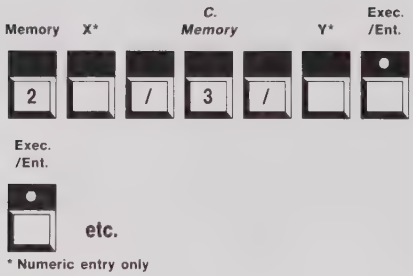
Stores measurement in V. Memory File X from C. Memory File Y

Stores measurement in V. Memory File X from currently selected 7400 Tape File

Stores measurement in V. Memory File X from 7400 Tape File Y

where X and Y can be assigned any memory file number between 0 and 31 999 or tape file number between 1 and the highest file number allocated by the 7400.

Pressing **Exec./Ent.** a second or third time after entry of any of the above sequences automatically updates the file numbers storing data in the next adjacent file, e.g.



Stores measurement in V. Memory File X from C. Memory File Y

Stores measurement in V. Memory File X+n from C. Memory File Y+n, where "n" is the number of times **Exec./Ent.** is pressed

Any attempt to store data in a store-secured file already containing data or transfering data from an empty file will permanently interrupt the above sequence plus print an error message, e.g. `File store-secured` or `File not found` .

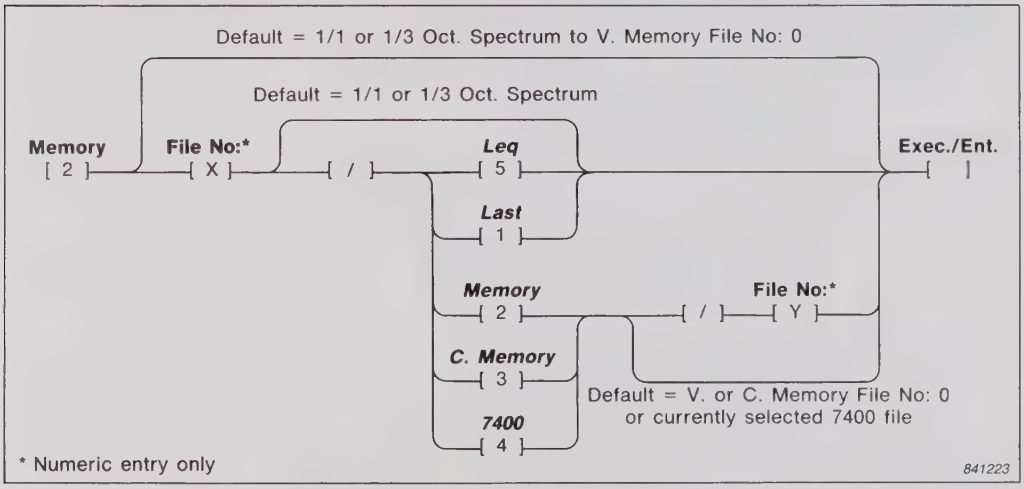


Fig. 4.8. Pushkey Sequence Chart – **Move to V. Memory**

4.2.4. Move to Continuous Memory [3] – Function No: 3

This is similar to the **Memory** function. An important difference is that measurements can be stored indefinitely, provided that the continuous memory is kept powered by the built-in Ni-Cd battery of the 2313 (see section 3.4). The maximum number of measurements which may be stored is as follows:

14 × 1/1 octave and Leq measurements, including 1/1 octave spectra processed with the Add, Subtract and Deviation functions
or 10 × 1/3 octave measurements plus 1/3 spectra processed with the Add, Subtract, Average and Deviation functions
or 5 × Time History and Simultaneous Spectra

The pushkey commands used for storing measurements are illustrated in Fig. 4.9 and are the same as those indicated in section 4.2.3, except that the **C. Memory** pushkey is used to initiate each sequence instead of the **Memory** key. Likewise, any group of successive memory files may be secured using the following control parameters which, except for function and parameter numbers indicated, are the same as those described in section 4.2.3.

```
SELECTED SETUP NO.: 0
  FUNCTION              PARAMETER                        VALUE       UNIT
  3 Cont. memory      1 Store-secured              :     -1     -1
  6 Delete            1 Cont. memory secured       :     -1     -1
```

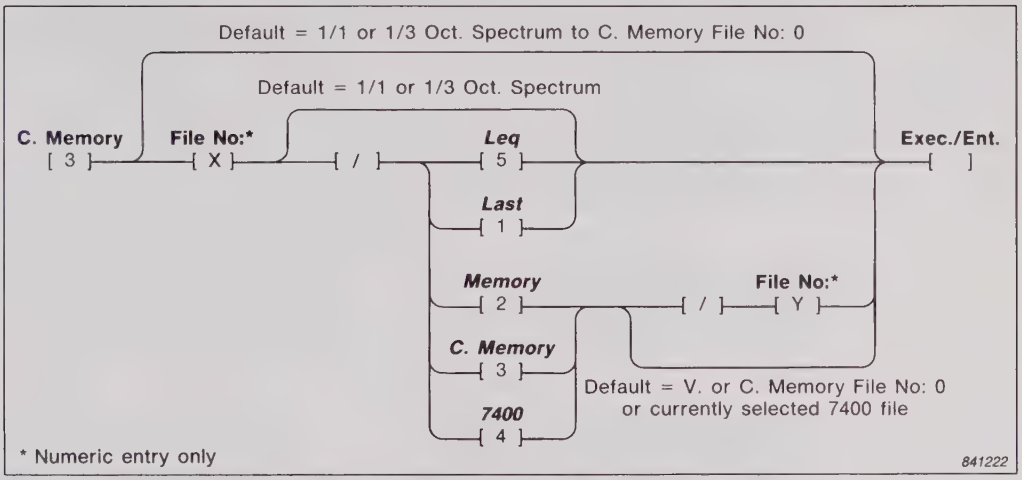


Fig. 4.9. Pushkey Sequence Chart – **Move to C. Memory**

4.2.5. Move to 7400 [4] – Function No: 4

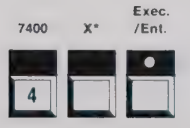
This function is useful for recording with the Digital Cassette Recorder Type 7400. Measurements performed directly by the 1617 and 2636 can be recorded, plus those stored or processed using 2313. The approximate number of measurements which can stored per side of a Digital Tape Cassette containing 300 m of tape is as follows:

1 200 × 1/1 octave and Leq measurements, including 1/1 octave spectra processed with the Add, Subtract and Deviation functions
or 900 × 1/3 octave measurements and 1/3 octave spectra processed with the Add, Subtract and Deviation functions
or 500 × Time History and Simultaneous Spectra

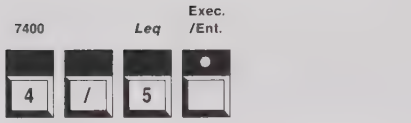
Basic Pushkey Commands:

For recording measurements with a 7400, the following pushkey sequences apply:

Activates 1/3 or 1/1 octave measurement, plus records result in currently selected 7400 Tape File

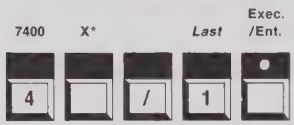


Activates 1/3 or 1/1 octave measurement, plus records result in 7400 Tape File X



Activates Leq measurement, plus records result in currently selected 7400 Tape File

Activates Leq measurement, plus records result in 7400 Tape File X

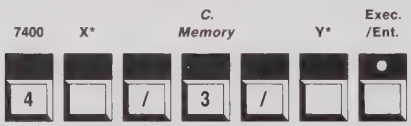


Records measurement in 7400 Tape File X from Last Memory

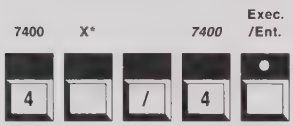
Records measurement in 7400 Tape File X from V. Memory File 0

Records measurement in 7400 Tape File X from V. Memory File Y

Records measurement in 7400 Tape File X from C. Memory File 0



Records measurement in 7400 Tape File X from C. Memory File Y



Records measurement in 7400 Tape File X from currently selected 7400 Tape File

Records measurement in 7400 Tape File X from 7400 Tape File Y

* Numeric entry only

With the 7400, measurements are recorded sequentially with File No: allocated by the Recorder. This means that when a blank Tape Cassette is fitted, no tape file number should be entered as the destination (i.e. File No: X) as the 7400 automatically selects file no: 1 for recording the first measurement, file no: 2 for the second, and so on. If, however, a tape already containing recorded measurements is used then tape File No: –1 (i.e. **[–][1]**) should be entered as the destination. This will spool the tape to the end of the last previously recorded tape file before continuing to record a new measurement.

Following execution of one of the above pushkey commands, the command can be reactivated simply by pressing the **Exec./Ent.** key. This will automatically update the file numbers for recording in the next adjacent file, thus making it possible to record a second or third measurement etc., without having to enter the entire pushkey command

each time. Any attempt to record data in a write-protected file, or one which is not write protected but is too small, will permanently interrupt the above sequence plus print an error message, e.g. `File not found` , `End of data` or `File substitution impossible due to file size`

Tape File Substitution:

Where it is required to delete a recorded measurement and substitute one from another tape or memory file, the file numbers of both the destination and source should be specified. With new 7400 Digital Cassette Recorders (from serial number 1091835) files containing measurements within the following groups may be substituted by another measurement file belonging to the same group:

Group 1: 1/1 octave and Leq measurements, plus 1/1 spectra processed with the Add, Subtract, Average and Deviation functions

Group 2: 1/3 octave measurements and 1/3 spectra processed with the Add, Subtract, Average and Deviation functions

Group 3: Time History and Simultaneous spectra

Measurement files may also be substituted with earlier 7400 Recorders (up to and including serial number 1091834). For this purpose the Recorders must be fitted with the File Substitution Option WH 1561 or Clock Option WH 1559.

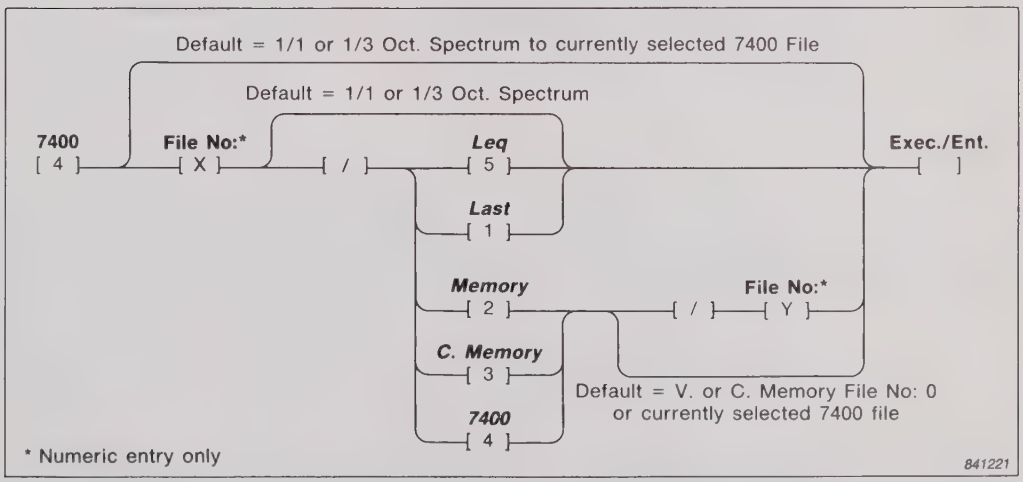


Fig. 4.10. Pushkey Sequence Chart – **Move to 7400**

4.2.6. Leq [5] – Function No: 5

Leq is used to determine the equivalent "steady-state" level of a fluctuating noise or sound level measured with the 2636 and is useful for assessing community and industrial noise pollution as well as noise exposure. Measurement is performed as described in section 4.1 and is based on the equal energy (3 dB amplitude/time doubling) principle prescribed by ISO 1996 and DIN 45 644. A typical example of an Leq readout, is shown in Fig. 4.11.

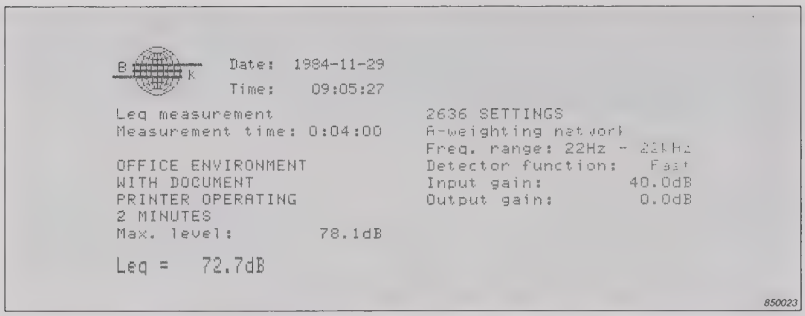
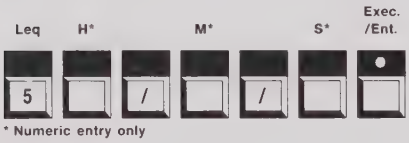


Fig. 4.11. Typical example of an Leq readout from the 2313

Basic Pushkey Commands:

For actuating Leq measurement, as well as listing results, there are two alternative push key commands:

Immediately starts Leq measurement, plus lists the result



Starts Leq measurement when built-in clock corresponds with the entered time **H**ours:**M**inutes:**S**econds, plus lists result

As indicated above, Leq measurement is initiated either just after the **Exec./Ent.** key is pressed or just after the built in clock corresponds with the particular start time entered in the key push command. In the latter case any start time up to 24 hours ahead of the current time can be specified, thus enabling measurements to be performed completely automatically without an operator in attendance. In order that measurement is started at exactly the required instant, it is important that the time entered includes both a 2-digit minutes and 2-digit seconds entry. Also, an allowance must be made if the **Autorange** function is employed (see section 4.5.5), as measurement can be delayed up to 16 seconds while the 2313 selects the appropriate measurement range with the 2636.

After measurement is initiated the 2313 selects the appropriate control settings on the 2636. With the default condition the "Fast" time-weighting and "A"-frequency weighting are chosen and the Leq measurement period or time set to 1 minute. For other measurement times or operation with the "Slow" time-weighting and/or a different frequency weighting, the set-up may be modified as indicated below.

When measurement is completed the 2313 automatically lists the result, plus returns the measuring arrangement to the control settings chosen before measurement was initiated. At the same time, it temporarily places the result in the Last Memory, thus enabling it to be stored in a V. or C. Memory file if further processing or reference documentation is required at a later date (see section 4.3.1).

If a too high a signal level is encountered at any time during measurement, an appropriate warning will be included in the readout, e.g. OVERLOAD . Also the percentage of the measurement time that underload or overload is present will be printed, e.g.

```
WARNING    overload  in     0.00%  of  measurements
           underload in    99.25%  of  measurements
```

Operating Set-Up Parameters:

```
SELECTED SETUP NO.: 0
  FUNCTION          PARAMETER                    VALUE      UNIT
5 Leq          1 Leq duration time      :        0          h
5 Leq          2 Leq duration time      :        1          m
5 Leq          3 Leq duration time      :        0          s
5 Leq          4 Standard A weight      : YES
```

1, 2 and 3–Leq duration time: Accept values between 0 and 59 for hour, minute and second entry respectively, with default value of 1 minute. Enable Leq measurement times from 0 seconds to 2 days, 11 hours, 59 minutes and 59 seconds to be obtained. Where zero hours, minutes and seconds are entered, the instantaneous "Fast" or "Slow" time weighted sound pressure level is output.

4–Standard A weight: Accepts logic **Yes** or **No**, with **Yes** as default. **Yes** selects Leq measurement with "Fast" time weighting and "A"-frequency weighting, while **No** enables "Fast" or "Slow" time-weighting together with any linear or frequency weighting to be manually selected on the 2636 prior to initiating the measurement.

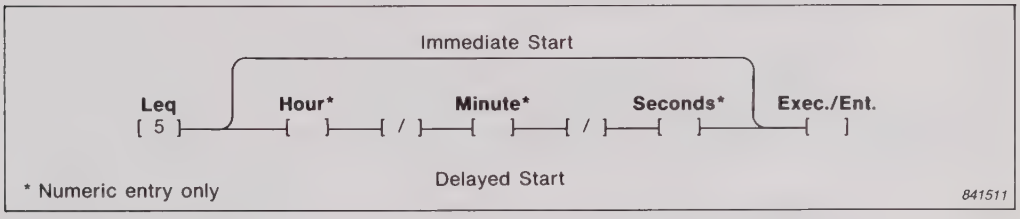


Fig. 4.12. Pushkey Sequence Chart – **Leq**

Note: Where it is required to transfer results of Leq measurement directly to a memory or tape file without listing results, **Leq** may be used with the **V. Memory**, **C. Memory** and **7400** functions described in sections 4.2.3 to 4.2.5. It is not possible to specify a start time, however.

4.2.7. Delete [6] – Function No: 6

The **Delete** function erases measurement data in any one or group of non delete-secured memory files of the 2313. In addition, it may be used to activate the 7400 Digital Cassette Recorder for erasing a complete side of a non-write protected Digital Tape Cassette.

Operating Set-Up Parameters:

For securing consecutive V. and C. Memory files of the 2313 against delete, Operating Set-Ups No: 1, 2 and 3 are equipped with the following control parameters, the use of which are discussed in section 4.2.3.

```
SELECTED SETUP NO.: 0
  FUNCTION          PARAMETER                      VALUE        UNIT
6 Delete       1 Memory secured           :      —1    —1
6 Delete       2 Contin. memory secured   :      —1    —1
```

With regard to measurements stored in the Last Memory of the 2313 and on tape with the 7400, accidental deletion of data using the **Delete** function is not normally possible. This is because the data source has to be specified in order to execute delete. Also tape recorded data can be write-protected against deletion or over recording, simply by folding back or removing the safety tabs on the rear of the tape cassette. See section 4.2.5.

Basic Pushkey Commands:

The pushkey commands used for deleting non delete-secured or write-protected measurement data, are as follows:

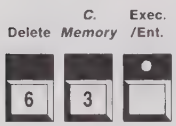
Deletes Last Memory

Deletes V. Memory file 0

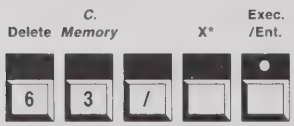
Deletes V. Memory file X

Deletes V. Memory file X to Y

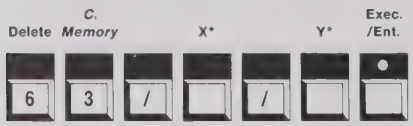
Deletes all V. Memory files



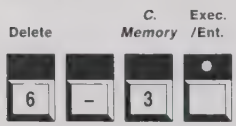
Deletes C. Memory file 0



Deletes C. Memory file X



Deletes C. Memory file X to Y



Deletes all C. Memory files

Deletes all 7400 tape files

* Numeric entry only

where X and Y can be assigned any memory file number between 0 and 31 999.

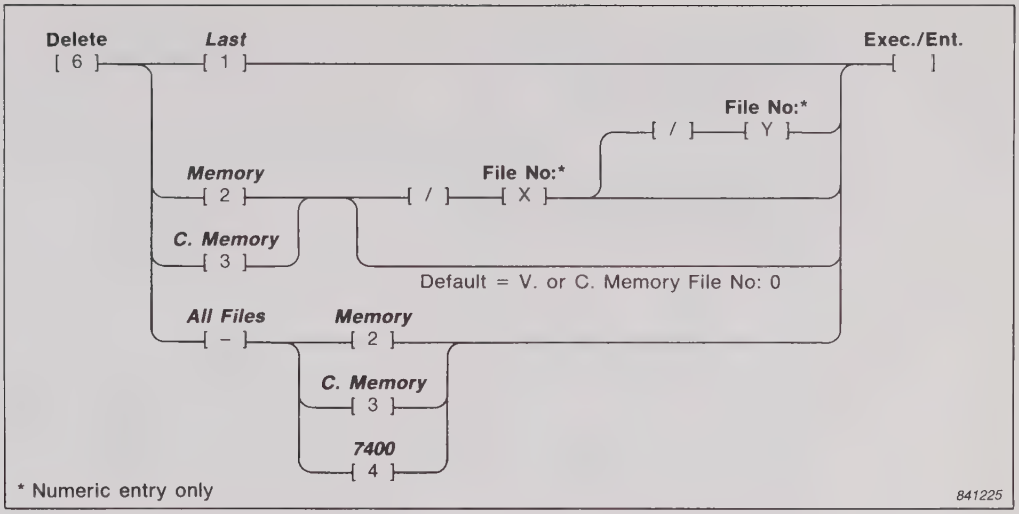


Fig. 4.13. Pushkey Sequence Chart – **Delete**

4.2.8. Memory Menu [7] – Function No: 7

This function itemizes the contents of the memory and tape files utilized for storing measurements. Besides specifying file number, date and time of storage, plus type of measurement stored, it prints SS or DS alongside those memory files which are store- or delete-secured (see Fig. 4.14., plus sections 4.2.3 and 4.2.7). Where 7400 tape files not recorded with the aid of the 2313 or tape files originating from another Application Package are encountered, Not a 2313 file or Not a BZ7005 file will be printed by the 2313.

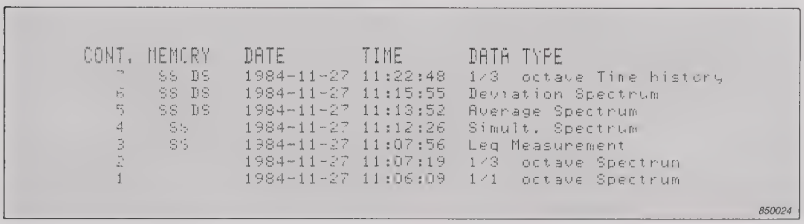

CONT. MEMORY DATE TIME DATA TYPE
7 SS DS 1984-11-27 11:22:48 1/3 octave Time history
6 SS DS 1984-11-27 11:15:55 Deviation Spectrum
5 SS DS 1984-11-27 11:13:52 Average Spectrum
4 SS 1984-11-27 11:12:26 Simult. Spectrum
3 SS 1984-11-27 11:07:56 Leq Measurement
2 1984-11-27 11:07:19 1/3 octave Spectrum
1 1984-11-27 11:06:09 1/1 octave Spectrum
850024

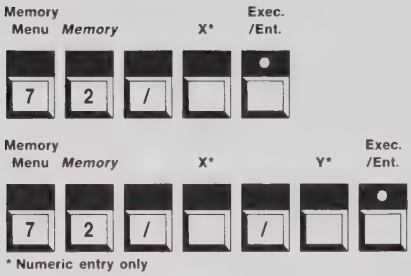
Fig. 4.14. Typical Memory Menu of measurements stored with the C. Memory of the 2313

Basic Pushkey Commands:

The pushkey commands for listing stored data with the **Memory Menu** function are as follows:

Itemizes contents of Last Memory

Itemizes contents of all V. Memory files



Itemizes contents of V. Memory file X

Itemizes contents of V. Memory Files X to Y

Similarly, for itemizing any one or group of C. Memory or 7400 tape files, press the ***C. Memory*** or ***7400*** key instead of the ***Memory*** key shown above (see also Fig. 4.15).

X and Y in the above can be assigned any memory file number from 0 to 31 999 and tape file number from 1 to the highest allocated by the 7400. Memory and tape files are itemized in chronological order, 7400 tape files are itemized in numerical order. Where a 7400 Soft-Function is stored on tape or in the V. Memory, it is denoted by its particular title.

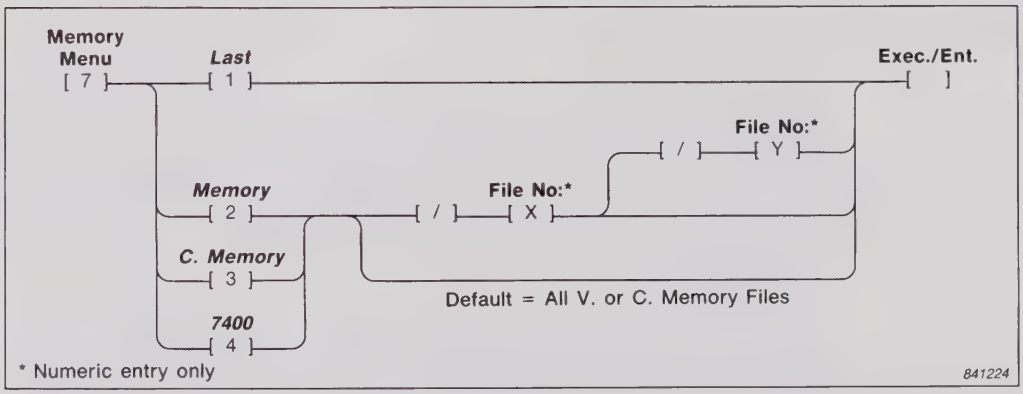


Fig. 4.15. Pushkey Sequence Chart – **Memory Menu**

4.3. SUB–FUNCTION GUIDE

Sub-functions are printed in cursive on the Control function Overlay and used to define the source from which measurement data is to be documented, stored or processed. As explained at the beginning of section 4.2, they may be entered after keying in a function when the **Entering LED** of the 2313 is lit.

4.3.1. *Last* [1] – Sub-function No: 1

The ***Last*** sub-function implicitly stores the latest operation carried out with the 2313 so that one can always refer to it prior to proceeding with the next operation. It may be used to list a measurement which was previously plotted, for example, or to transfer results to a V. or C. Memory file etc. The types of measurement data which may be stored are:

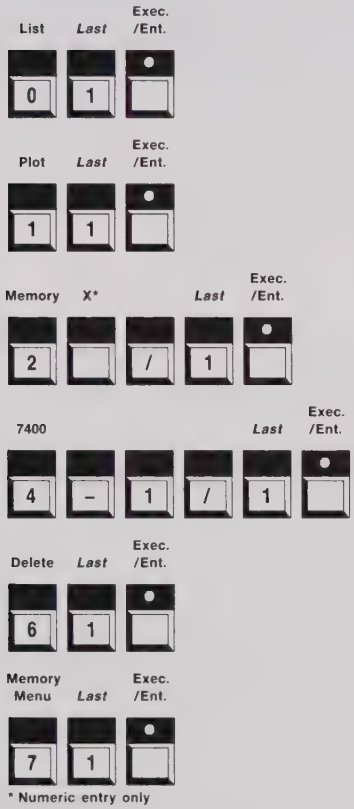
- 1/3 and 1/1 octave measurements
- Leq measurements
- Time History spectra

Simultaneous spectra
Add, Subtract, Average and Deviation spectra

The information is placed in a special volatile memory file and therefore is retained as long as the 2313 is powered. If, however, an error arises during execution of an operation or measurement, then the information will be automatically deleted.

Basic Pushkey Commands:

The basic pushkey commands ultilizing the ***Last*** sub-function, are as follows:



Lists previous measurement retained in Last Memory

Plots previous measurement retained in Last Memory

Stores previous measurement in V. Memory File X from Last Memory

Records previous measurement from Last Memory in next 7400 File free for recording

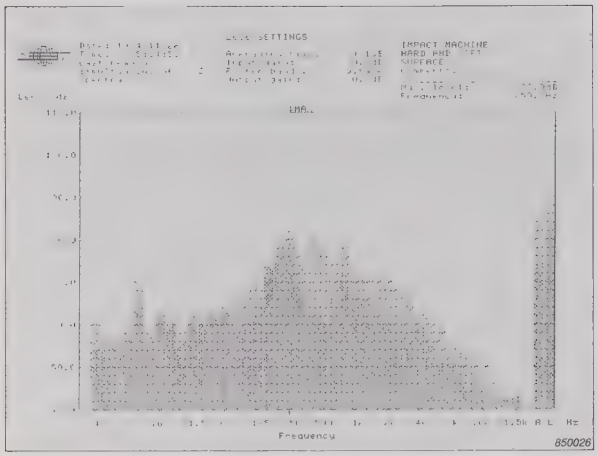
Deletes previous measurement retained in Last Memory

Prints menu of previous measurement retained in Last Memory

where X can be assigned any memory file number between 0 and 31999.

4.3.2. *Average* [7] – Sub-function No: 17

Average is a sub-function of **List** and **Plot**. It is used to determine the average spectrum of a series of 1/3 or 1/1 octave band spectra or time histories when these are recorded using compatible controls settings on the 1617 and 2636 and are stored in consecutive volatile memory files of the 2313. A typical readout obtained with the ***Average*** sub-function is shown in Fig. 4.16.



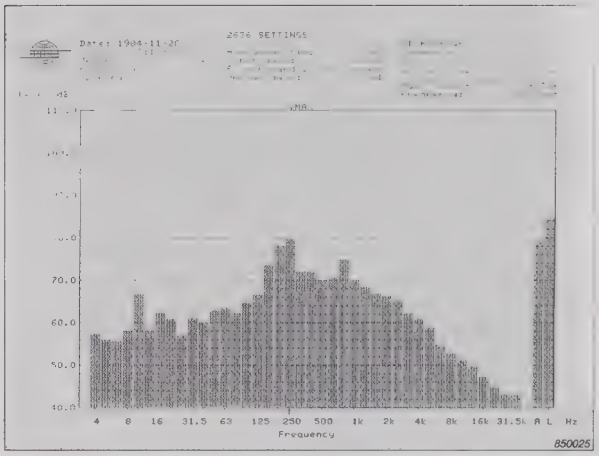
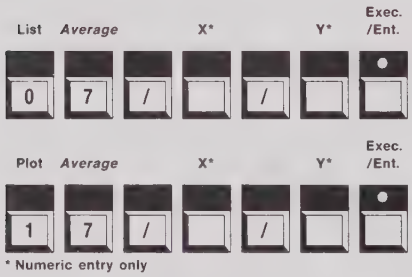


Fig. 4.16. Two 1/3 Octave Spectra plus their average spectrum (dB-form) as plotted using the 2313

Basic Pushkey Commands:

The basic pushkey commands employed for averaging, plus listing and plotting results are as follows:



Lists average spectrum of measurement series from V. Memory Files X to Y

Plots average spectrum of measurement series from V. Memory Files X to Y

where X and Y can be assigned any memory file number between 0 and 31 999.

It should be noted that the control settings specified in the readout are always those of the first measurement in the series processed. If one or more of the measurements are overloaded or make use of different gain, averaging time, centre frequency range and weighting settings, the list or plot will contain an `OVERLOAD` or `DIFFERENT SETTINGS` warning. In contrast, the ***Averaging*** sub-function will be automatically terminated and a `Memories of different type` error message printed, if non compatible or illegal types of stored measurement are encountered, e.g. a mixture of 1/3 or 1/1 octave measurements, a series of Leq measurements, etc.

On completion of a readout, the results of averaging are automatically placed in the last memory and therefore may be transferred to a V. or C. Memory file if further documentation is required at a later date (see section 4.3.1). They cannot be processed or documented using the ***Time History*** or ***Simultaneous*** sub-functions, however.

Operating Set-Up Parameters:

Utilizing the **Set-Up** mode of the 2313, either arithmetic averaging or averaging in dB form may be selected. Selection is made by entering **Yes** for arithmetic and **No** for averaging in dB form (see below). Arithmetic determines the equivalent RMS value (i.e.

antilog$_{10}$ dB level/10) of the signal level within corresponding frequency or time history bands, whilst that in dB form operates directly in dB and extracts the mean level.

```
SELECTED SETUP NO.: 0
   FUNCTION                PARAMETER                          VALUE        UNIT
SUBFUNCTIONS:
 17 Average spectra     1 Arithmetical                 : YES
```

1–Arithmetical: Accepts logic **Yes** for arithmetic averaging (and default), plus **No** for averaging in dB form.

4.3.3. *Deviation* [8] – Sub-function No: 18

This is a sub-function of **List** and **Plot**, and evaluates the standard amplitude deviation between corresponding frequency bands of a series of spectra stored in the volatile memory of the 2313. Both 1/3 and 1/1 octave band spectra, as well as time histories may be processed. However, it is important to note that only similar types of measurement can be handled at any one time. Also, they must have been stored in consecutive volatile memory files of the 2313.

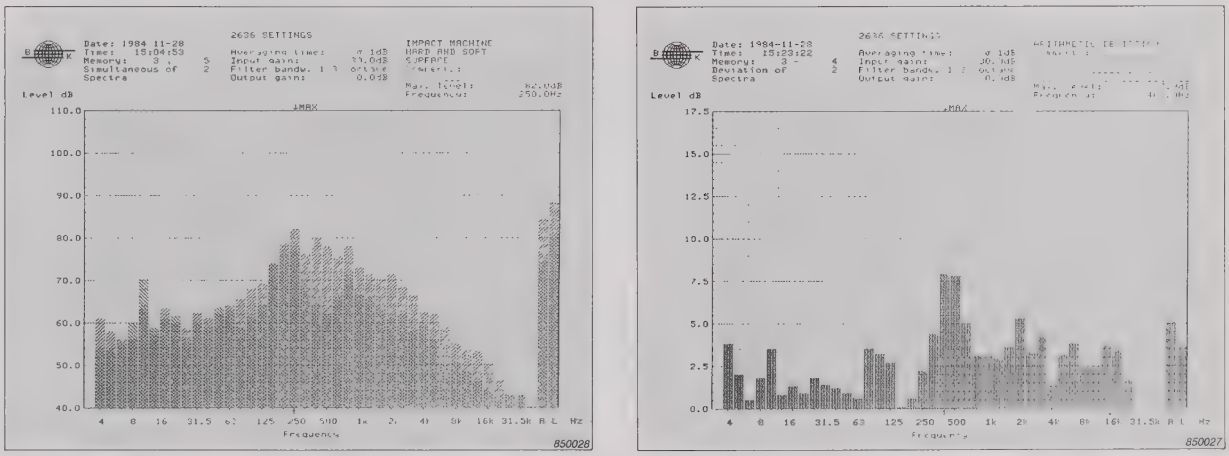
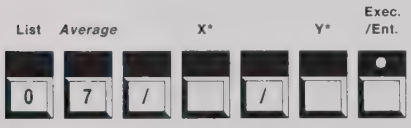


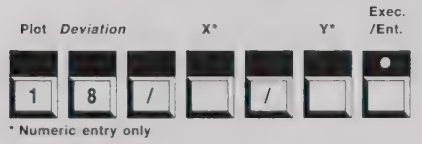
Fig. 4.17. Two 1/3 Octave Spectra plus Standard Deviation Plot (arithmetic-form) showing the amplitude deviation between corresponding frequency bands of the two spectra

Basic Pushkey Commands:

The basic pushkey commands for obtaining a ***Deviation*** readout are as follows:



Lists deviation spectrum of measurement series from V. Memory Files X to Y



Plots deviation spectrum of measurement series from V. Memory Files X to Y

* Numeric entry only

where X and Y can be assigned any memory file number between 0 and 31 999.

It should be noted that the control settings specified in the readout are always those of the first measurement in the series processed. If one or more of the measurements are overloaded or make use of different gain, averaging time, centre frequency range and weighting settings, the list or plot will contain an `OVERLOAD` or `DIFFERENT SETTINGS` warning. In contrast, the ***Deviation*** sub-function will be automatically terminated and a `Memories of different type` error message printed, if non compatible or illegal types of stored measurement are encountered, e.g. a mixture of 1/3 or 1/1 octave measurements, a series of Leq measurements, etc.

On completion of a deviation readout, the results are automatically placed in the last memory and therefore may be transferred to a V. or C. Memory file if further documentation is required at a later date (see section 4.3.1). They cannot be subjected to further processing or documentation using the ***Time History*** or ***Simultaneous*** sub-functions, however.

Operating Set-Up Parameters:

Using the **Set-Up** mode the ***Deviation*** sub-function may be set to provide either the arithmetic deviation or the deviation in dB form as indicated below. Both give the standard deviation in dB, however, with the former amplitude samples are based on RMS values (i.e. *antilog$_{10}$ dB level/10*), whilst with the latter they are in dB.

```
SELECTED SETUP NO.: 0
   FUNCTION              PARAMETER                    VALUE      UNIT
SUBFUNCTIONS:
 18 Deviation spectra  1 Arithmetical          : YES
```

1–Arithmetical: Accepts logic **Yes** for arithmetic deviation (and default), plus **No** for deviation in dB form.

Note: Due to the wide difference in results obtained with the two forms of deviation measurement, it is not always possible to obtain an on scale readout with the **Plot** function. Normally, however, this can easily be rectified by altering the **"Graphic offset"** and **"Scale proportion"** parameters of the **Plot** function. See section 4.2.2.

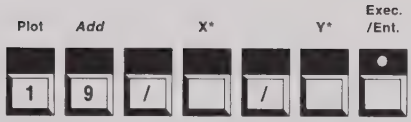
4.3.4. *Add Spectra* [9] – Sub-function No: 19

With this sub-function any two 1/3 or 1/1 octave band spectra or time histories of the same type may be summed which are stored in the V. Memory. Practical applications are in the summation of spectra from different noise sources. Either the equivalent RMS amplitude (i.e. *antilog$_{10}$ dB level/10*) or the dB level of corresponding frequency or time bands of the spectra may be summed, depending on whether arithmetic summation or summation in dB form is chosen with the Operating Set-Ups (see below).

Basic Pushkey Commands:

The pushkey commands for adding two stored measurements of the same type, are as follows:

Adds measurement stored in V. Memory File X and Y, plus lists result



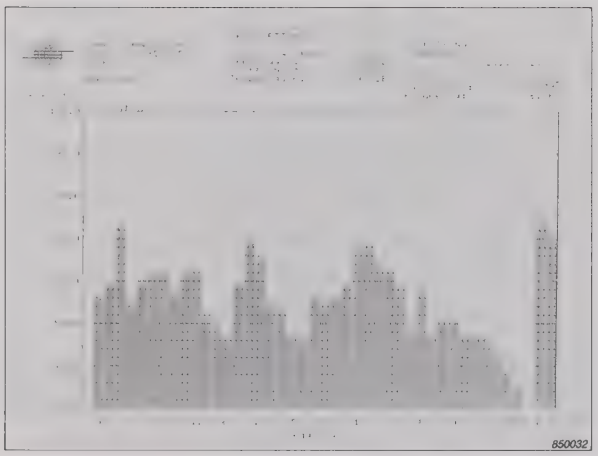
Adds measurement stored in V. Memory File X and Y, plus plots result

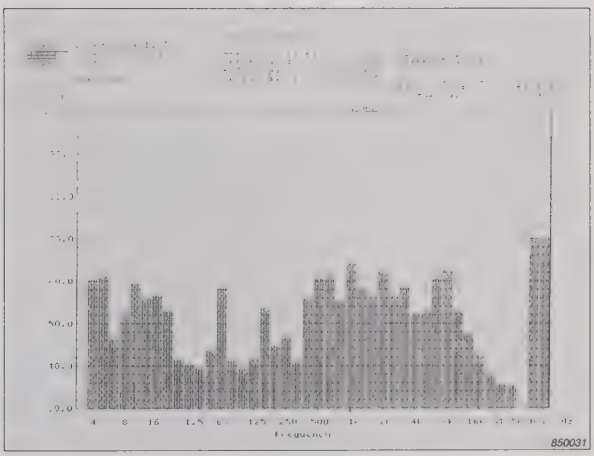
where X and Y can be assigned any memory file number between 0 and 31 999.

It should be noted that the control settings specified in the readout are always those of the first measurement in the series processed. If the measurements are overloaded or make use of different control settings, the list or plot will contain an `OVERLOAD` or `DIFFERENT SETTINGS` warning.

In contrast, the ***Add*** sub-function will be automatically terminated and an `Illegal input to function` or `Memories of different type` error message printed, if non compatible types of stored measurement or wrong type of memory file are encountered. Similarly, a `Data out of range -100 to 300dB` error message will be generated, if the results of addition are outside the limits specified.

On completion of a readout, the results are automatically placed in the last memory and therefore may be transferred to a V. or C. Memory file if documentation or further processing is required at a later date. See section 4.3.1.





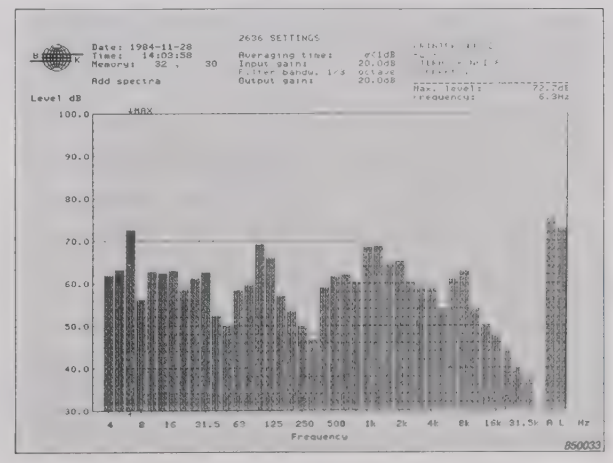


Fig. 4.18. Summation of 1/3 octave spectra from two different noise sources

Operating Set-Up Parameters:

```
SELECTED SETUP NO.: 0
   FUNCTION                PARAMETER                          VALUE        UNIT
SUBFUNCTIONS:
 19 Add spectra          1 Arithmetical                 : YES
```

1–Arithmetical: Accepts logic **Yes** for arithmetic summation (and default), plus **No** for summation in dB form. Arithmetic adds the equivalent RMS level of the signal amplitudes within corresponding frequency bands, whilst that in dB form operates directly in dB.

4.3.5. *Simultaneous* [0] – Sub-function No: 20

This is a sub-function of **Plot** and is capable of documenting any two 1/3 or 1/1 octave band spectra or time histories, simultaneously. Measurements must be of the same type and have been previously recorded in the Volatile Memory. Where measurements stored in another memory file or 7400 file are concerned, they must first be transferred to the Volatile Memory. Any attempt to process dissimilar types of measurement, generates an appropriate error message, e.g. `Memories of different type` .

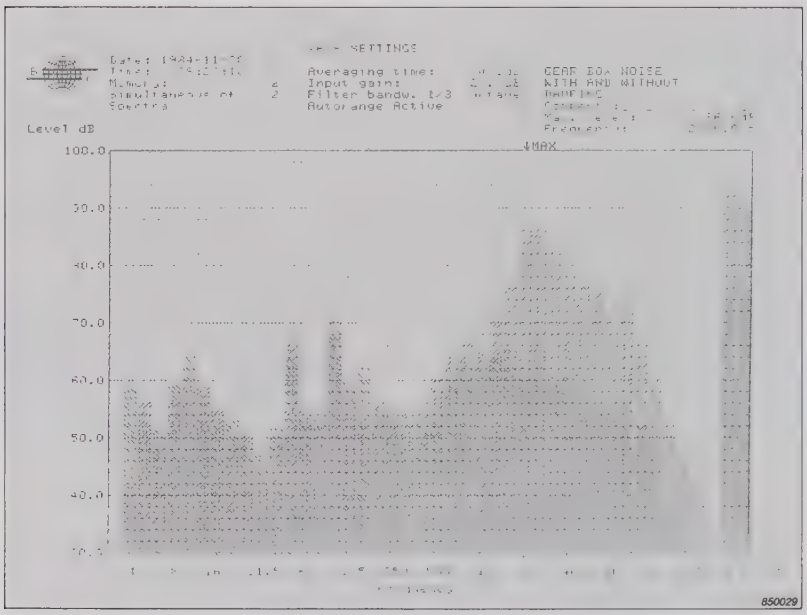
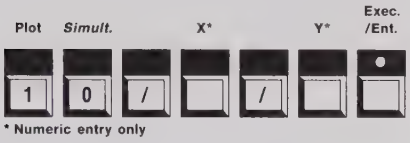


Fig. 4.19. Simultaneous plot of two 1/3 octave spectra

An example of the type of readout produced is shown in Fig. 4.19. To help identify the separate measurements, plus show their individual levels without one hiding the other, each is plotted with a contrasting raster. Normally an accurate level indication is obtained, regardless of whether the same **Input** and **Output Gain** settings of the Measuring Amplifier are used for originally recording the measurements or not. However, where different settings have been used, a `DIFFERENT SETTINGS` warning will be printed at the top of the plot. The control settings indicated in the readout are alway those of the first measurement specified in the pushkey command used for initiating the plot.

Basic Pushkey Command:

The pushkey command for readout of a Simultaneous Plot, is as follows:



Plots measurements from V. Memory Files X to Y

where X and Y can be assigned any memory file number between 0 and 31 999.

On completion of a simultaneous plot, results are placed in the Last Memory, thus enabling them to be transferred to a V. or C. Memory file for readout at a later date. For subsequent readout of spectra already processed using the ***Simult.*** sub-function, the **Plot** function should be used instead. Use of ***Simult.*** with the **List** function is not possible.

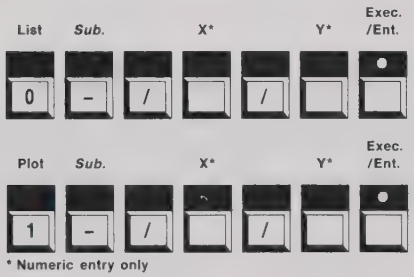
4.3.6. *Subtract Spectra* [–] – Sub-Function No: 21

With this sub-function any two 1/3 or 1/1 octave band spectra or time histories of the same type may be subtracted which are stored in the V. Memory. Either the equivalent RMS amplitude (i.e. $antilog_{10}$ *dB level/10*) or the dB level of corresponding frequency bands of the spectra may be subtracted, depending whether arithmetic subtraction or subtraction in dB form is chosen with the Operating Set-Ups (see below).

Practical uses are arithmetic subtraction of unwanted background noise from measurements such as illustrated in Fig. 4.20. Where negative quantities are encountered with arithmetic subtraction they are treated as 0 dB in the result. With subtraction in dB form, they are indicated by a minus sign or a lighter raster.

Basic Pushkey Commands:

The basic pushkey commands for subtracting one stored measurement from another, are as follows:



Subtracts V. Memory File Y from File X, plus lists result

Subtracts V. Memory File Y from File X, plus plots result

where X and Y can be assigned any memory file number between 0 and 31 999.

On completion of a readout, results are automatically placed in the last memory and therefore may be transferred to a V. or C. Memory file if documentation or further processing is required at a later date. See section 4.3.1.

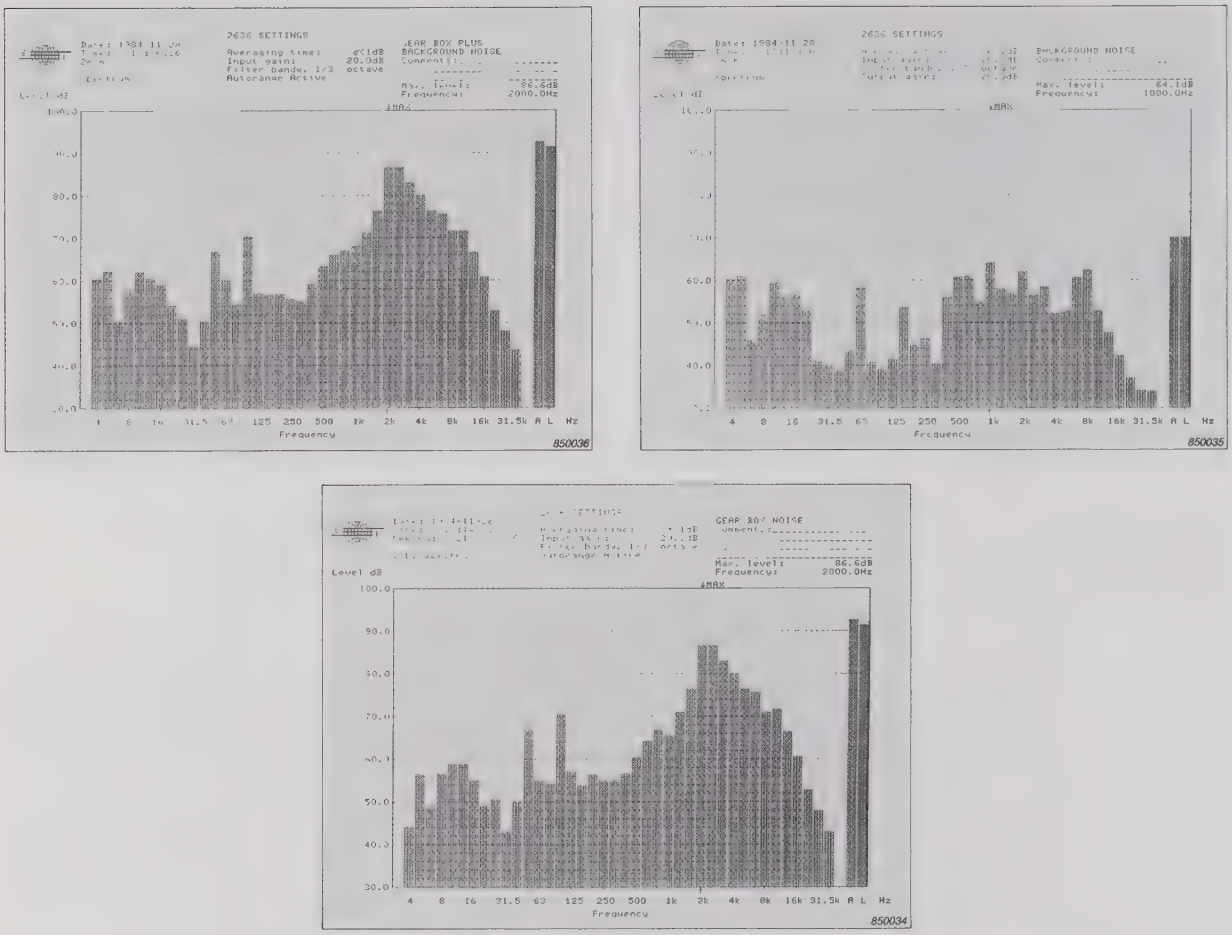


Fig. 4.20. Machine noise spectrum minus background noise spectrum

It should be noted that the control settings specified in the readout are always those of the first measurement in the series processed. If the measurements are overloaded or make use of different control settings, the list or plot will contain an **OVERLOAD** or **DIFFERENT SETTINGS** warning.

In contrast, the ***Sub.*** sub-function will be automatically terminated and an **Illegal input to function** or **Memories of different type** error message printed, if non compatible types of stored measurement or wrong type of memory file are encountered. Similarly, a **Data out of range -100 to 300dB** error message will be generated, if the results of subtraction are outside the limits specified.

Operating Set-Up Parameters:

```
SELECTED SETUP NO.: 0
   FUNCTION                PARAMETER                          VALUE       UNIT
SUBFUNCTIONS:
 21 Sub. spectra        1 Arithmetical                : YES
```

1–Arithmetical: Accepts logic **Yes** for subtraction in arithmetic form (and default), plus **No** for subtraction in dB form. Arithmetic subtracts equivalent RMS level of the signal amplitudes within corresponding frequency bands, whilst that in dB form operates directly in dB.

4.3.7. *Time History* [22] – Sub-function No: 22

With this sub-function the time history of a series of Leq measurements which have been stored in consecutive volatile memory files may be documented using the **List** and **Plot** functions. Alternatively, the time history of any preselected centre frequency or frequency weighting band of a series of 1/3 or 1/1 octave band measurements may be listed or plotted.

Utilizing ***Time History***, as many as 160 single band measurements may be documented at one time which makes it useful in investigating the work day noise history of machinery or the noise exposure of personnel working in the immediate vicinity. For example, using **Enter Sequence** function for storing a key push sequence (see section 4.4.5), 160 Leq measurements may be performed over an 8 hour period and individually stored in consecutive volatile memory files to produce the time history plot similar to that shown in Fig. 4.21.

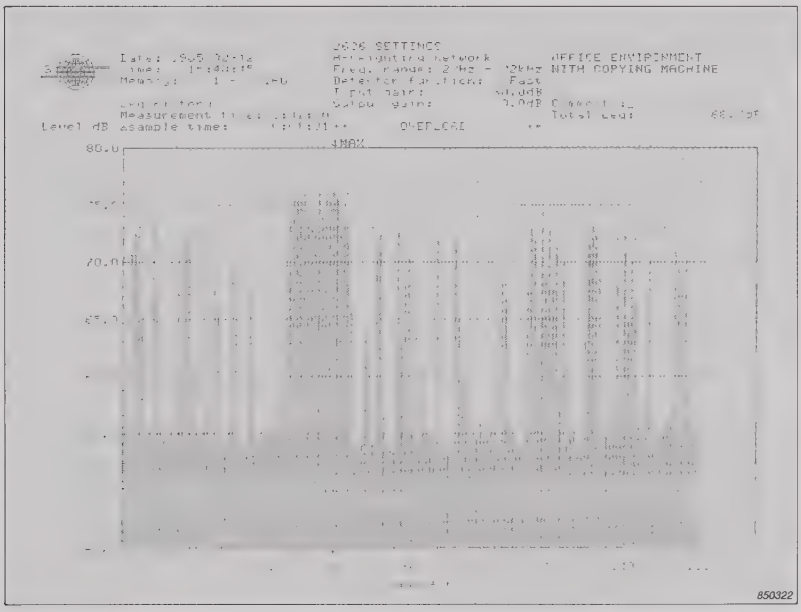
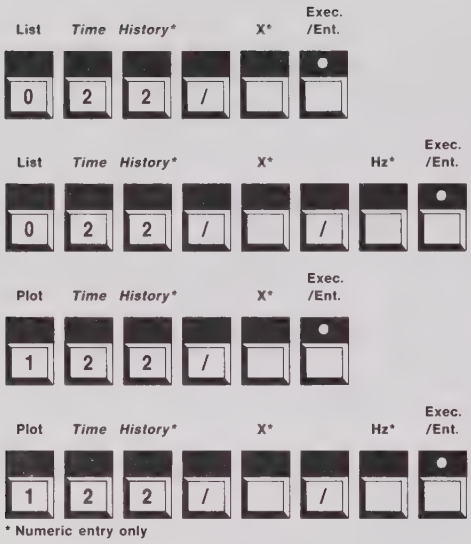


Fig. 4.21. Typical time history plot of Leq measurement series

Whereas with Leq measurements any measurement time from 1 s to 59 hours, 59 minutes and 59 seconds may be chosen (see section 4.2.6), with 1/3 and 1/1 octave band measurements it depends on the particular centre frequency range and averaging time selected for the measurements and can range from approximately 1,5 s for a one band measurement to 1 hour and 48 minutes for all 50 1/3 octave bands (see section 4.5). Provided that the measurement time is the same for each measurement, then the measurement interval will be printed at the top of the time history readout.

Basic Pushkey Commands:

The pushkey commands used for documenting an Leq, 1/3 oct., or 1/1 oct. time history are as follows:



Lists time history of Leq measurement series from V. Memory Files ≥ X

Lists time history of 1/3 or 1/1 oct. measurement series from V. Memory Files ≥ X

Plots time history of Leq measurement series from V. Memory Files ≥ X

Plots time history of 1/3 or 1/1 oct. measurement series from V. Memory Files ≥ X

where the first file of the measurement series and the particular frequency band to be sampled may be entered as a one to five digit number, the latter being automatically rounded to the nearest 1/3 octave centre frequency by 2313. Before entering this data, however, the number of measurement files to be sampled should be set using the **Set-Up** mode of the Recorder. See Operating Set-Up Parameters, described below.

If the number of files requested is greater than that actually used for storing the measurement series, then the time history readout will be inhibited and a corresponding error message generated instead, e.g. `File not found` .

Where the time history for the Linear band of a stored measurement series is required, the first 1/3 or 1/1 octave band immediately after the last band of the measured spectrum should be keyed in using the above commands. Similarly, where readout of the weighting band is required, the second 1/3 or 1/1 octave band after the last band of the measured spectrum should be entered. For example, if the 20 kHz band is the last 1/1 octave band measured, the 25 kHz and 31,5 kHz bands should be entered for the linear and weighting band time history.

It should be noted that the control settings specified in the readout are always those of the first measurement in the series processed. If one or more of the stored measurements are overloaded or make use of different gain, averaging time or frequency weighting settings, the time history list or plot will contain an `OVERLOAD` or `DIFFERENT SETTINGS` warning. In contrast, the ***Time History*** sub-function will be automatically terminated and an `Illegal input to function` or `Memories of different type` error message printed, if non compatible types of stored measurement or wrong type of memory file are encountered.

On completion of a time history readout, results are automatically placed in the Last Memory, thus enabling them to be transferred to a V. or C. Memory file to supply reference documentation at a later date. Alternatively, they may be stored to facilitate further processing using the ***Add***, ***Subtract***, ***Average*** and ***Deviation*** sub-functions of the 2313.

Operating Set-Up Parameters:

```
SELECTED SETUP NO.: 0
   FUNCTION                PARAMETER                          VALUE       UNIT
SUBFUNCTIONS:
 22 Time history       1 Number of files            :        39
```

1–Number of files: Accepts values from 0 to 160, and has the default value of 39. It is used to specify the maximum number of consecutive memory files sampled for a time history readout. To permit readout, it is important that the number of files set with the ***Time History*** function does not exceed that actually used for storing the measurement series.

4.4. EXTENDED FUNCTION GUIDE

Due to limited space certain functions and sub-functions are not indicated on the Overlay. These are chosen using two or more separate key strokes as indicated in the following sections. Functions making use of the **Extension [/]** key are termed extended functions and like the main functions may be selected when the **Active LED** of the 2313 is lit.

4.4.1. Personal Text [/] [100] – Extended Function No: 110

The **Personal Text** function enables up to 20 characters of text to be entered or edited via the front panel into one or more of the text lines. There are 5 text lines which, if activated in the current Operating Set-Up, appear in the documentation heading of all lists or plots generated by the 2313 (see Fig. 4.22). The inserted text is stored in the continuous memory.

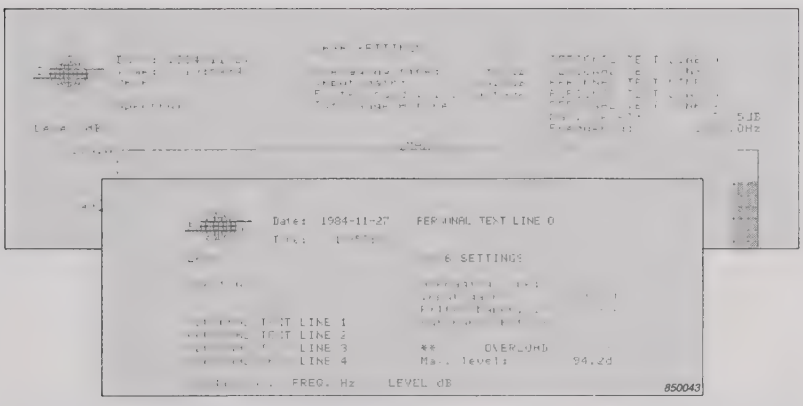


Fig. 4.22. Location of Personal text lines 0, 1, 2, 3 and 4 in the documentation heading of Lists and Plots generated by the 2313

Operating Set-Up Parameters:

The Operating Set-Ups available with the **Personal Text** function are shown below and are for the default case. Note that the Set-Ups are used for enabling or disabling the text. Entering personal text is covered later.

```
        SELECTED SETUP NO.: 0
           FUNCTION                PARAMETER                    VALUE      UNIT
        SUBFUNCTIONS:
(7100) 110 Personal text      1 Enable line 0          : NO
(7100) 110 Personal text      2 Enable line 1          : NO
(7100) 110 Personal text      3 Enable line 2          : NO
(7100) 110 Personal text      4 Enable line 3          : NO
(7100) 110 Personal text      5 Enable line 4          : NO
```

By selecting **110 Personal Text**, the individual text lines can be enabled or disabled by pressing the **Yes** or **No** pushkey respectively when entering the VALUE in the Set-Up procedure. Note that even if enabled, these text lines will only appear on the **List** read-out if its **"Including heading"** control parameter is enabled. See section 4.2.1.

Entering Personal Text:

Text can be entered and edited in the 5 text lines from 3 sources; over the IEC/IEEE Interface (covered in section 6.6.13), over the Serial Interface (covered in section 7.1.1), or via the 2313 front panel.

Text is entered via the front panel by first selecting either the "Number" or "Character" mode.

Character Mode:

In the "Character" mode, the decimal equivalent of the ISO character is entered, separated by a **[/]** key push. The characters available with their decimal equivalents are given in Table 4.1. Note that numbers can also be entered in character mode by entering their decimal equivalent.

No.	Char.	No.	Char.	No.	Char.	No.	Char.	No.	Char.	No.	Char.	No.	Char.	No.	Char.
0	Δ	16	π	32	SP	48	0	64	@	80	P	96	`	112	p
1	α	17	∫	33	!	49	1	65	A	81	Q	97	a	113	q
2	²	18	æ	34	"	50	2	66	B	82	R	98	b	114	r
3	Σ	19	σ	35	#	51	3	67	C	83	S	99	c	115	s
4	δ	20	τ	36	$	52	4	68	D	84	T	100	d	116	t
5	ε	21	ü	37	%	53	5	69	E	85	U	101	e	117	u
6	φ	22	√	38	&	54	6	70	F	86	V	102	f	118	v
7	ω	23	–	39	'	55	7	71	G	87	W	103	g	119	w
8	Ω	24	↑	40	(	56	8	72	H	88	X	104	h	120	x
9	⁰	25	↓	41	)	57	9	73	I	89	Y	105	i	121	y
10	₀	26	→	42	*	58	:	74	J	90	Z	106	j	122	z
11	Ø	27	←	43	+	59	;	75	K	91	[	107	k	123	{
12	λ	28	¯	44	,	60	<	76	L	92	\	108	l	124	|
13	μ	29	_	45	–	61	=	77	M	93	]	109	m	125	}
14	±	30	|	46	.	62	>	78	N	94		110	n	126	¯
15	■	31	|	47	/	63	?	79	O	95	_	111	o	127	DEL

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Table 4.1 List of personal text characters available with numbers used when writing the characters in the "Character" mode

Pushkey Label	Effect
Help	Print selected text line
Exec./Ent.	Stop
/	Move to next character position
Clear Entry	Clear selected text line and return to first character position
0 to 127	Write (or overwrite) character according to Table 4.4
–	Delete character and move to next character position
.	Return to first character position
E	Move to previous character position

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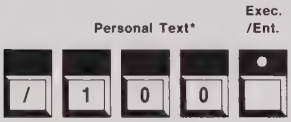
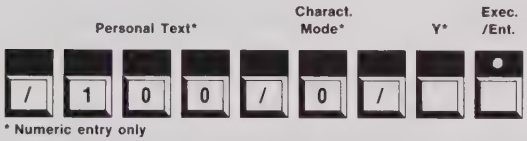
Table 4.2. Commands when operating in Personal Text "Character" mode

The pushkey commands for accessing the "Character" mode are as follows:



Selects Personal Text "Character" mode – text line 0

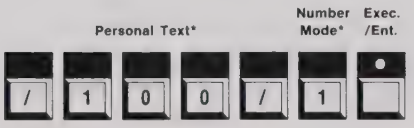


Selects Personal Text "Character" mode – text line Y where 0≤Y≤4

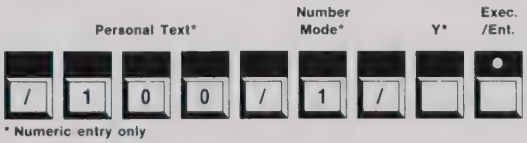
Once the "Character" mode has been selected using one of the above pushkey sequences, the text in the selected text line can be inserted or edited by using the key commands listed in Table 4.2.

Number Mode:

In the "Number" mode, the numbers '**0**' to '**9**', '**E**' and '**.**', as printed on the pushkeys, are entered directly. The pushkey commands for accessing the "Number" mode are as follows:



Selects Personal Text "Character" mode – text line 0



Selects Personal Text "Number" mode – text line Y where 0≤Y≤4

Once the "Number" mode has been selected using one of the above pushkey sequences, the text in the selected text line can be inserted or edited by using the key commands listed in Table 4.3.

Pushkey Label	Effect
Help	Print selected text line
Exec./Ent.	Stop
/	Move to next character position
Clear Entry	Clear selected text line and return to first character position
0 to 9, –, . , E	Write (or overwrite) with number

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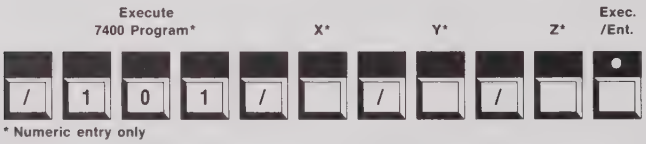
Table 4.3. Commands when operating in the Personal Text "Number" mode

4.4.2. Execute 7400 Program [/] [101] – Extended Function No: 111

This function loads the 2313 with a B&K "soft-function" program from the 7400 Digital Cassette Recorder and then executes it like a normal function. Soft-functions permit new documentation and measurement functions to be added to suit more specialised applications, and will be available at a later date from the B&K Software Department. Please contact your local B&K representative for details.

Basic Pushkey Command:

The pushkey command for loading and/or executing a stored soft-function program is as follows:



Loads and executes soft-function from 7400 File X

where X is the tape file number allocated by the 7400, and Y and Z are the parameter values indicated in the literature accompanying the soft-function. Where no parameters are indicated, Y and Z can be ignored.

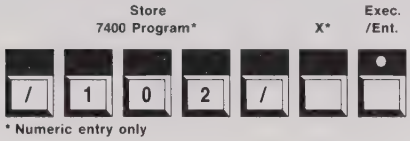
When loaded the soft-function is stored in a special volatile memory file and then executed. Only one soft-function may be stored at a time and it is retained up until time the 2313 is switched off or when another function is executed which requires the use of this file. If required the stored function can be executed a second or third time, simply by pressing the **Exec./Ent.** key to repeat the above command. Any attempt to load and execute a 7400 file not containing a soft-function will return the 2313 to standby, plus print an `Error in code function` message.

4.4.3. Store 7400 Program [/] [102] – Extended Function No: 112

This function enables a work copy to be made on the user's own tape, of a soft-function program which has been previously loaded in the 2313 using the **Execute 7400 Program** function (see section 4.4.2).

Basic Pushkey Command:

The pushkey command for storing a program on 7400 tape is as follows:



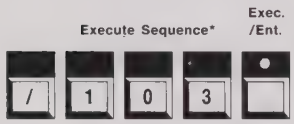
Copies soft-function in 7400 file X from the 2313

4.4.4. Execute Sequence [/] [103] – Extended Function No: 113

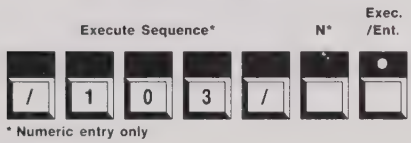
Execute Sequence executes a key push sequence, previously entered and stored in the continuous memory using the **Enter Sequence** function in section 4.4.5. If the sequence contains one or more illegal or non existent functions and parameters, it will be terminated and an appropriate error message printed. It is not possible to activate the sequence via the IEC/IEEE Interface of the 2313 or store it using an external medium such as the 7400.

Basic Pushkey Command:

The pushkey commands for executing a stored pushkey sequence are as follows:



Executes once a key push sequence stored in the 2313



Executes "N" times, a stored key push sequence, where $0 \leqslant N \leqslant 29999$

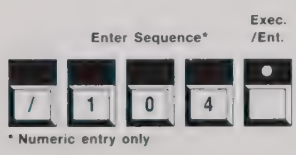
Two examples showing the use of **Execute Sequence**, are given in section 4.4.5.

4.4.5. Enter Sequence [/] [104] – Extended Function No: 114

The **Enter Sequence** function enables the user to enter and store a pushkey sequence containing up to 250 key pushes. This allows an automatic control sequence to be developed which can be executed using the **Execute Sequence** function described in section 4.4.4. All key pushes are saved in the continuous memory, except **Reset** which ends entry of a sequence. If required the sequence can be edited using the **Edit Sequence** function described in section 4.4.6. Entry of a pushkey sequence via the IEC/IEEE Interface of the 2313 is not possible.

Basic Pushkey Command:

The pushkey command for entering a pushkey sequence is as follows:



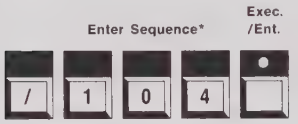
The following key pushes are saved by the 2313 until **Reset** is pressed

Examples of Use:

To illustrate use of the **Enter Sequence** function, two examples are given. The first gives a key push sequence for automatic documentation and storage of a single Leq measurement. Measurement starts at 11.15 a.m.

1. Using the **Set-Up** mode, select an appropriate Operating Set-Up and activate the **Autorange** function 204 for automatic control of the 2636 **Input Section Gain**. See sections 3.9 and 4.5.5.

2. Press the **Reset** key to deactivate the **Set-Up** mode and key in the following automatic control sequence:



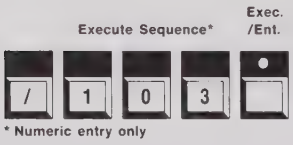
Initiates **Enter Sequence** function for entry and storage of the following key push sequence

Initiates Leq measurement at 11:15:00, plus lists result

Retrieves result of last measurement, plus stores it in V. Memory File 10

Terminates **Enter Sequence** function, storing the above key push sequence

3. Execution of stored key push sequence:

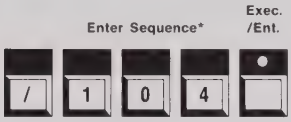


Executes stored key push sequence once

As the second example (see below) a key push sequence for automatic recording of 1/3 band spectra into consecutive 7400 tape files is given. The measurement sequence starts at 9.45 am and is repeated at 5 minute intervals with aid of the **Wait Clock** and **Wait** functions of the instrument. After the first execution the **Wait Clock** time is ignored. Also shown are use of the **Relay On** and **Relay Off** functions for automatic switching of the test source.

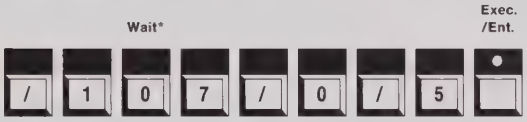
1. Using the **Set-Up** mode, select an appropriate Operating Set-Up and activate the **Autorange** function 204 for automatic control of the 2636 **Input Section Gain**. See sections 3.9 and 4.5.5.

2. Press the **Reset** key to deactivate the **Set-Up** mode and key in the following automatic control sequence:



Initiates **Enter Sequence** function for entry and storage of the following key push sequence

Delays continuation of sequence until 9:45:00



Delay for repeating sequence at 5 minute intervals

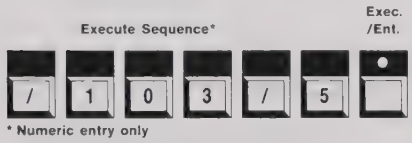
Activates test source via the **Remote Control** socket of the 2313 (see section 4.4.11)

Command initiating 1/3 oct. measurement, plus storing result in next 7400 File free for recording

Deactivates test source (see section 4.4.11)

Terminates **Enter Sequence** function, storing the above key push sequence

3. Execution of stored key push sequence:



Executes stored sequence 5 times, storing results in 5 consecutive tape files

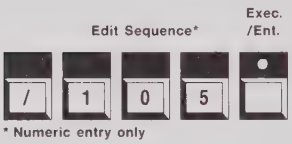
The above example makes use of the fact that the 7400 automatically increments the tape file number, i.e. it automatically stations the tape at the start of the next tape file after recording each measurement. To perform a similar operation with the V. or C. Memory of the 2313, the file number has to be incremented using the **Shift** function described in section 4.4.7.

4.4.6. Edit Sequence [/] [105] – Extended Function No: 115

This function enables editing of a pushkey sequence, whereby individual key pushes can be changed, inserted or deleted. The sequence is entered and stored in the continuous memory using the **Enter Sequence** function in section 4.4.5.

Basic Pushkey Command:

The pushkey command for editing a pushkey sequence is as follows:



Enables stored sequence to be edited according to Table 4.4 until **Exec/Ent** is pressed to stop editing

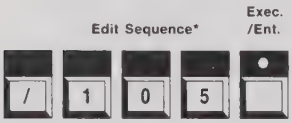
Pushkey Label	Effect
Help	List sequence
〈0 to max.〉 〈Exec./Ent.〉	Select keypush line number
/ 〈Keypush〉	Insert 〈Keypush〉 in selected lne number
–	Delete keypush
.	Select next keypush line
E	Select previous keypush line
Exec./Ent.	Stop

T00311GB0

Table 4.4 Commands when operating in the **Edit Sequence** *Mode*

Example of Use:

For changing the Leq measurement start time in the first **Enter Sequence** example (see section 4.4.7) from 11.15 to 11.10 am., one must first select the appropriate line, delete it and then insert a new line in place of it. The procedure for doing this is as follows:



Selects **Edit Sequence** mode, providing printout of the commands given in Table 4.4.

Selects line number 5 of the stored sequence, printing 5 5

Deletes selected line, printing its new contents, i.e. 5 / in this case

Inserts 0 into line 5, giving a printout of the line, i.e. 5 0

Ends the Edit Sequence mode

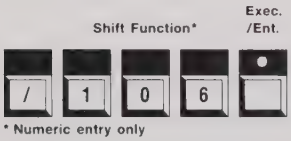
4.4.7. Shift Function [/] [106] – Extended Function No: 116

As discussed at the start of section 4.2 and in subsequent sections, the **Exec./Ent** key may be used to repeat execution of certain functions plus automatically update their parameters. For carrying out the same operation with a stored key push sequence, however, a separate function termed **Shift** must be employed. This is intended for direct inclusion in a key push sequence stored with the **Enter Sequence** function and serves to fetch a function plus increment its parameter each time the sequence is executed.

Besides allowing information to be stored in or recalled from successive memory or tape files, the **Shift** function enables a stored key push sequence to be used for a number of separate tasks simply by entering a new function prior to executing the sequence. It is, however, only possible to fetch a single function at a time, whose parameter is to be incremented.

Basic Pushkey Command:

The pushkey command for executing the **Shift** function is as follows:



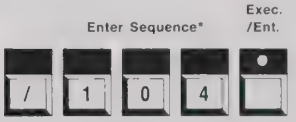
Fetches function plus increments its parameter

Examples of Use:

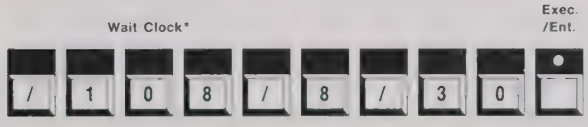
The usefulness of the **Shift** function can be clarified by the following example. This gives the key push sequence for automatic measurement of 10 separate 1 minute Leq measurements, plus lists and stores each measurement result in consecutive V. Memory files of the 2313. Measurement starts at 8.30 am and is repeated at 2 minute intervals.

1. Using the **Set-Up** mode, select a suitable Operating Set-Up and activate the 2636 **Autorange** function 204 contained in the Set-Up. See sections 3.9 and 4.5.5.

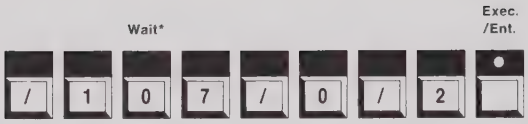
2. Press the **Reset** key to deactivate the **Set-Up** mode and key in the following automatic control sequence:



Initiates **Enter Sequence** function for storing the following key push sequence

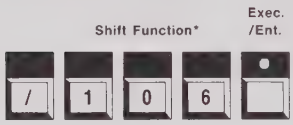


Delays continuation of sequence until 8.30 am



Delay for repeating sequence at 2 minute intervals

Initiates Leq measurement plus lists result

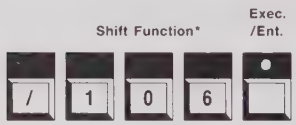


Enters **Shift** function, to fetch and increment the V. Memory function defined in item 3

Commands execution of function defined in item 3

Terminates **Enter Sequence** function, storing above key push sequence

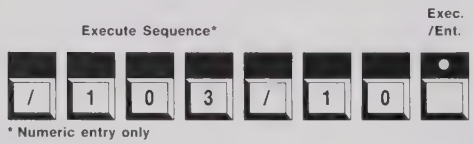
3. Entry of function to be incremented:



Initiates **Shift** function for retrieving and incrementing the following function

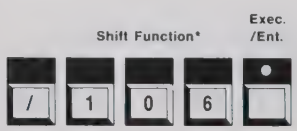
Command for storing last Leq measurement in V. Memory starting at File 10

4. Execution of stored sequence and incremented function:



Executes stored sequence 10 times, storing successive Leq measurements in V. Memory files 10 to 19

Where it is required to place each Leq measurement directly in the V. Memory of the 2313 without providing a readout each time, entry of the **List Leq** command in item 2 of the above sequence should be ignored and item 3 changed as follows:

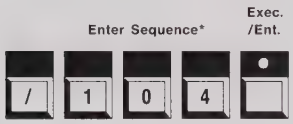


Initiates **Shift** function for retrieving and incrementing the following function

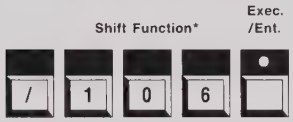
Command for storing Leq measurement in V. Memory starting at File 10

As a second example, the method of individually saving 1/3 or 1/1 octave band measurements in successive V. Memory and 7400 files is given.

1. Entry and storage of key push sequence for retrieving and incrementing the function initiated in item 2 below.

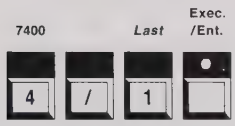


Initiates **Enter Sequence** function for storing the following key push sequence

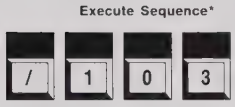


Enters **Shift** function, to fetch and increment the V. Memory function defined in item 2

Commands execution of function defined in item 2



Command to retrieve last measurement result and store it in the correct 7400 File

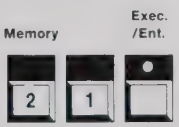


Enters command to repeat the above key push sequence

Terminates **Enter Sequence** function, storing the above key push sequence

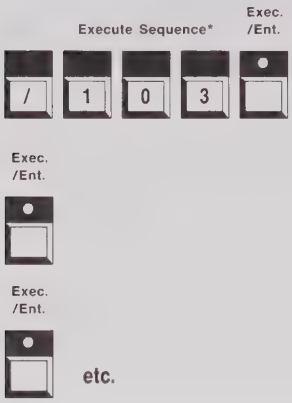
2. Entry of function to be incremented:

Initiates **Shift** function for retrieving and incrementing the following function



Command for storing 1/3 octave band measurement in V. Memory, starting at File 1

3. Execution of stored sequence and incremented function:



Executes stored key push sequence, to perform 1/3 octave measurement plus store result in V. Memory File 1 and 7400 File 1

Initiates new measurement, storing result in V. Memory File 2 and 7400 File 2

Initiates new measurement, storing result in V. Memory File "n"+1 and 7400 File "n"+1

4. Press the **Reset** key to deactivate the **Execute Sequence** function and return the 2313 to standby.

Note: Pressing the **Reset** key just before, during or after execution of a stored pushkey sequence will delete the function to be incremented. In order to re-execute the sequence afresh, one must repeat entry of the function to be incremented, i.e. repeat items 2 and 3.

4.4.8. Wait [/] [107] – Extended Function No: 117

When a time is entered and this function is executed as part of a 250-step key push sequence (see section 4.4.5), the 2313 waits until the actual clock time is an exact multiple of the inserted time in seconds before continuing with the sequence.

Example 1: If 1 hour is inserted as the wait time and the clock is at 8:45:15 the 2313 will wait until 9:00:00 (i.e. 1 hour × 9) before executing the sequence. If the sequence is repeated it will be re-executed at 10:00:00 (i.e. 1 h × 10), 11:00:00 (i.e. 1 h × 11), etc.

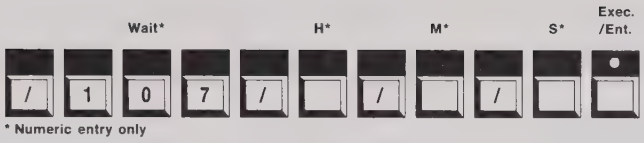
Example 2: If 18 minutes is inserted as the wait time and the clock is at 00:59:10 the 2313 will wait until 01:12:00 (i.e. 18 minutes × 4) before executing the sequence. If the sequence is repeated it will be re-executed at 01:30:00 (i.e. 18 m × 5), 01:48:00 (i.e. 18 m × 6), etc.

Example 3: If 1 minute 40 seconds (i.e. 100 s) is inserted as the wait time and the clock is at 10:40:20 the 2313 will wait until 10:41:40 (i.e. 100 s × 3845) before executing the sequence. If the sequence is repeated it will be re-executed at 10:43:20 (i.e. 100 s × 3846), 10:45:00 (i.e. 100 s × 3847), etc.

Utilizing **Wait** in a key push sequence, allows time for a function to be completed before continuing to the next step. In addition, it ensures functions are initiated at regular time intervals independent of the time it takes to execute the function.

Basic Pushkey Command:

The pushkey command for inserting the wait time is as follows:



where H is the number of hours (0 to 23), M is the number of minutes (0 to 59) and S is the number of seconds (0 to 59).

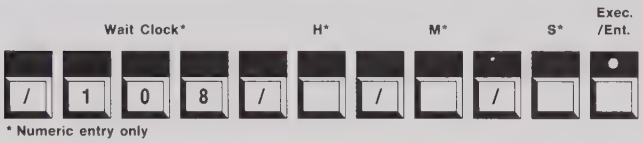
Examples, illustrating the use of the **Wait** function, are given in sections 4.4.5 and 4.4.7.

4.4.9. Wait Clock [/] [108] – Extended Function No: 118

When a time is entered and **Wait Clock** is executed as part of a 250-step key push sequence, the 2313 waits until the entered time corresponds with the 2313 clock time before continuing with the sequence. A further feature is that if this function is repeated with the same time as previously used, this function is ignored. This enables a sequence to be performed a number of times where the 2313 waits for the clock the first time only. The key push sequence can be entered using **Enter Sequence** or edited using **Edit Sequence**. See sections 4.4.5 and 4.4.6 respectively.

Basic Pushkey Command:

The pushkey command for inserting the wait clock time is as follows:



where H is the number of hours (0 to 23), M is the number of minutes (0 to 59) and S is the number of seconds (0 to 59).

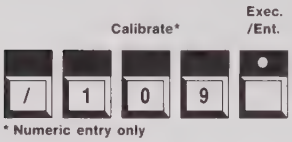
Examples, illustrating the use of the **Wait Clock** function, are given in sections 4.4.5 and 4.4.7.

4.4.10. Calibrate [/] [109] – Extended Function No: 119

The **Calibrate** function provides a quick, accurate means of checking the calibration of the 2636, as well as automatically correcting the readout of the 2313 for minor calibration errors caused by incorrect adjustment of the 2636. In addition, it may be used to correct the readout of the 2313 when measurement transducers with sensitivity outside the normal adjustment range of the 2636 are employed.

Before using the **Calibrate** function, the 2636 should be calibrated. For this purpose either its built-in reference voltage or an external reference source may be employed as described in the Instruction Manual for the 2636. When calibration is completed the 2636 should be kept connected with the reference source and the reference level produced by the source entered in the current Operating Set-Up with the aid of the **2-Set Level to** parameter mentioned below.

Having carried out the above, the **Calibrate** function may be actuated by entering the following push key command:



Checks calibration of the 2636 plus determines the dB offset needed to obtain a calibrated readout

When actuated, the 2313 will immediately print whether autocalibrate is enabled with the Set-Up's **1–Active** parameter, and will then proceed to check the calibration of the measurement arrangement. Provided that the 2636 is precisely calibrated (i.e. 2636 reference level input to the 2313 corresponds exactly with the reference level specified in the Set-Up), a readout similar to the following will be generated:

```
        Input value   94.0dB is changed by    0.0dB to   94.0dB
```

which indicates that no calibration offset need be applied. If calibration is not correct, however, an offset other than 0,0 dB will be indicated which at the same time will be entered directly in the current Set-Up to permit automatic correction of the 2313 readout when autocalibrate is enabled in the Set-Up. Furthermore, the offset is indicated in the control heading of all future readouts corrected with **Calibrate** function. The maximum offset which may be applied is ±20dB.

Operating Set-Up Parameters:

```
        SELECTED SETUP NO.: 0
           FUNCTION              PARAMETER                    VALUE        UNIT
(/109) 119 Calibrate          1 Active                   : NO
(/109) 119 Calibrate          2 Set level to             :    94            dB
(/109) 119 Calibrate          3 Cal. offset              :  0.0000E+00      dB
```

1–Active: Accepts logic **Yes** or **No**, with **No** as default. **Yes** enables autocalibrate for a calibrated readout of measured levels (i.e. include Cal. offset specified in the Set-Up), while **No** selects readout without the Cal. offset.

2–Set level to: Accepts reference levels between –20 and +200 dB (re. 1 μV or 20 μPa) in 1 dB steps, with 94 dB (i.e. 50 mV or 1 Pa) as default. It should be set to the reference level generated by the particular calibration source used with the 2636.

3–Cal. offset: For manual or automatic entry of offsets between –2.000000E+01 and +2.000000E+01 dB (i.e. ±20 dB), with default at 0.000000E+00 (i.e. 0 dB). Is used to define the calibration or measurement offset added to the readout of the 2313 when the **1–Active** parameter is set to **Yes**.

4.4.11. Relay On [/] [110] – Extended Function No: 120
Relay Off [/] [111] – Extended Function No: 121

These are for inclusion in a 250-step key push sequence and permit remote switching of external equipment coupled to the **Remote Control** socket on the rear panel of the 2313. For example, by employing **Relay On** and **Relay Off** together with the **Wait Clock** and **Wait** functions an automatic control sequence may be developed which automatically switches on or off an external noise source at a preset time or fixed time interval (see section 4.4.5).

Basic Pushkey Command:

The pushkey commands for activating **Relay On** and **Relay Off**, are as follows:

Opens relay contacts, switching on B&K Noise Source

* Numeric entry only

Closes relay contacts, switching off B&K Noise Source

Relay On is factory preset to open circuit pins 2 and 5 of the **Remote Control** socket (see Fig. 2.5), while **Relay Off** interconnects them. This is directly suited for switching on and off the B&K Sound Power Source Type 4205 and Noise Source Type 4224. For connection of these sources to the **Remote Control** socket, a standard 8 pin DIN Cable AQ 0034 may be used.

For use with other external equipment which require a make connection for activation, **Relay On** (and **Relay Off**) can be modified accordingly. This is done by carefully easing off the red lead from the interface board pin J8 shown in Fig. 4.23 and fitting it to pin J9 indicated. The interface board is mounted on the rear panel and is accessible on sliding off the top panel which is fastened by two screws on the back of the instrument. Before attempting to release the top panel ensure that the 2313 is disconnected from the mains supply.

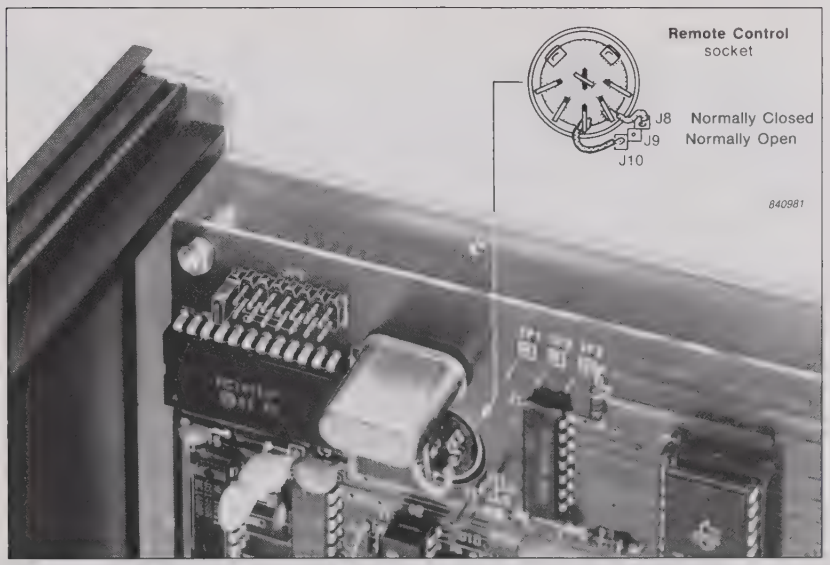


Fig. 4.23. **Relay On–Relay Off** *connections on the digital interface board of the 2313*

4.5. COMMON SET–UP FUNCTION GUIDE

Under COMMON SET–UP of Operating Set-Up No: 0, 1, 2 and 3 are five functions. These have the parameter and default values indicated below and govern the basic control settings selected for Leq, as well as 1/3 and 1/1 octave band measurements with the 1617 and 2636.

```
SELECTED SETUP NO.: 0

COMMON SETUP:
200 Add Lin and W      1 Weighting          : No weight channel   ◀
201 Averaging          1                    : 1/2s                ◀
202 Filter             1                    : 1/3 octave          ◀
203 Frequency          1 Start              : 12.5000E+00    Hz
203 Frequency          1 End                : 160.0000E+03   Hz
204 Autorange          1 NO                 :
204 Autorange          2 Overload margin    : 10 — 20dB           ◀
```

The functions and parameters may be set as explained in section 3.9.4. The ◀ arrow symbols denote which parameter values or settings may be stepped using the **Yes** key. Parameter values not including an arrow accept numerical data (or logic **Yes** or **No**). Once a parameter value is set, the appropriate control setting is automatically chosen each time a measurement is initiated with the 2313.

4.5.1. Add Lin. and Weight – Common Function No: 200

Using this function, the "D", "A", "B" or "C" weighting band of the 1617 together with the "22,4 Hz – 22,4 kHz" linear band of the 2636, may be chosen for 1/3 or 1/1 octave band measurements. Once enabled in the Operating Set-Up, using the **Yes** key to step the parameter to the required weighting, the desired bands are automatically selected immediately measurement with 1/3 or 1/1 octave bands is completed. Following measure-

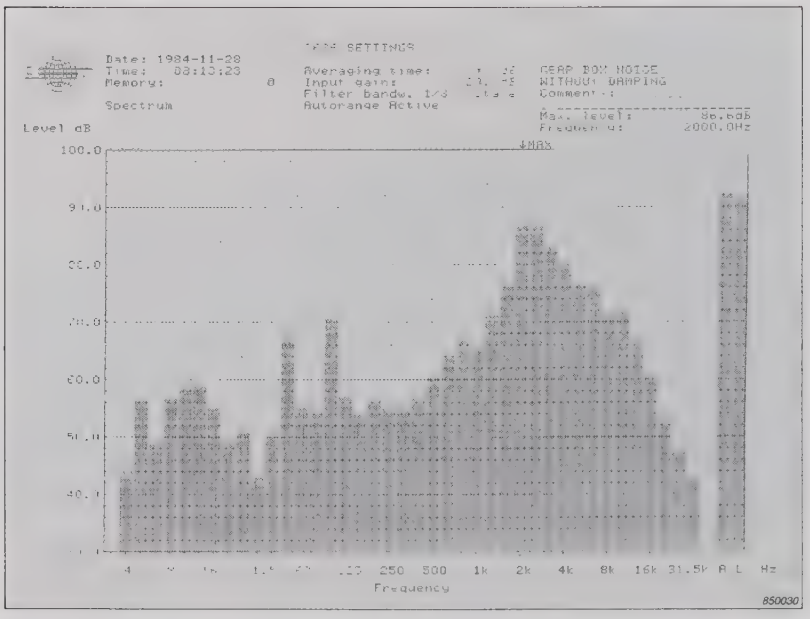


Fig. 4.24. Typical 1/3 band plot generated by the 2313 with Lin and "A"-Weighted band included

ment the linear and weighted levels are included in the readout of the 2313, or are stored together with other data associated with the measurement. For measurements without the linear or weighting bands, the **"No weight channel"** setting (i.e. default condition) should be selected in the Set-Up.

Note: For Leq measurements the appropriate frequency weighting characteristic chosen with the **Filter** keys of the 2636 applies (see section 4.2.6).

4.5.2. Averaging – Common Function No: 201

With this function RMS averaging with either a constant averaging time or a constant confidence level may be selected for 1/3 and 1/1 octave measurements. Averaging is performed digitally by the 2313 using a linear process where all data sampled within any given frequency band has an equal influence on the result. For Leq measurements the standardized **"Fast"** or **"Slow"** time weighting selected with the **Detector Function** knob of 2636 applies (see section 4.2.6).

For measurements with a constant averaging time there is the choice of eleven settings from 1/8 to 128 seconds. Similarly, for measurements with a 68 % constant confidence level, three settings from $\sigma<0{,}5$ to $\sigma<2$ dB may be selected. The desired setting is chosen using the **Yes** key to step through each setting in turn, and in the default condition is set to 1/2 s.

Once a setting is chosen in the Operating Set-Up, it is automatically selected each time a 1/3 or 1/1 octave band measurement is initiated with the 2313. During measurement, full control of the averaging process is passed to the 2313 which disables **Averaging Control** of the 1617. It then continuously switches the detector averaging time of the 2636 between 0,1 and 30 s to permit readout and sampling of measured values within each frequency band of the 1617.

Operation with Constant Averaging Time:

For operation with a constant averaging time, the settings specified in Tables 4.5 and 4.6 are recommended. These are suited for averaging of random signals and are determined using the following expression which gives the relative standard deviation σ of the measured RMS level in dB:

$$\sigma = \frac{4{,}34}{\sqrt{B\,T_A}}$$

where B is the measuring bandwidth in Hz of the first filter band selected for analysis and T_A is the averaging time in seconds.

The expression is an approximate relationship, but carries sufficient accuracy for BT_A products equal to, or greater than, 10. It expresses the limits of the signal level variation to a confidence level of approximately 68 %, i.e. there is 68 % probability that the measurement result will be within $\pm\sigma$ of the true value, 96 % probability that it will be within $\pm 2\sigma$, and 99 % probability that it will be within $\pm 3\sigma$.

Also indicated in Tables 4.5 and 4.6, is overall time required to complete an analysis with a constant averaging time setting. To keep the measurement time as short as possible, a start and end frequency band corresponding with the particular frequency range of interest should be chosen in the Operating Set-Up (see section 4.5.3). Alternatively, averaging with a constant confidence level should be selected.

1/1 Octave Analysis				
Averaging Time T_A	Analysis Time up to 16 kHz T_{max}	Confidence Level at Start Frequency $\sigma < 0{,}5$ dB	$\sigma < 1$ dB	$\sigma < 2$ dB
1/8 s	0:10	1000	250	63
1/4 s	0:15	500	125	31,5
1/2 s	0:20	250	63	16
1 s	0:25	125	31,5	8
2 s	0:45	63	16	4
4 s	0:20	31,5	8	2
8 s	2:00	16	4	–
16 s	4:10	8	2	–
32 s	7:15	4	–	–
64 s	15:20	2	–	–
128 s	30:00	–	–	–
		Start Frequency Hz		

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Table 4.5. Recommended Averaging Time settings for 1/1 octave band measurements on random signals up to 16 kHz. Also indicated is the overall time required for measurements when started with the averaging times and centre frequency bands indicated

1/3 Octave Analysis				
Averaging Time T_A	Analysis Time up to 160 kHz T_{max}	Confidence Level at Start Frequency $\sigma < 0{,}5$ dB	$\sigma < 1$ dB	$\sigma < 2$ dB
1/8 s	0:25	2500	630	160
1/4 s	0:35	1250	315	80
1/2 s	0:45	630	160	40
1 s	1:10	315	80	20
2 s	2:00	160	40	10
4 s	3:40	80	20	5
8 s	7:25	40	10	2,5
16 s	12:50	20	5	–
32 s	27:30	10	2,5	–
64 s	50:00	5	–	–
128 s	1:48:00	2,5	–	–
		Start Frequency Hz		

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Table 4.6. Recommended Averaging Time settings for 1/3 octave band measurements on random signals up to 160 kHz. Also indicated is the overall time required for measurements when started with the averaging times and centre frequency bands indicated

Operation with Constant Confidence Level:

For analysis with a constant confidence level the same relation as specified above is used. In this case, however, the 2313 automatically steps the averaging time to help maintain a constant BT product with each 1/3 or 1/1 octave centre frequency band selected. Besides helping maintain a constant accuracy throughout the measurement, this gives the benefit that the overall time required to complete the measurement is considerably reduced especially where measurements a frequencies below 12,5 Hz are concerned (see Tables 4.5, 4.6 and 4.7).

Start Frequency	1/1 Octave Analysis			1/3 Octave Analysis		
	Confidence Level			Confidence Level		
	$\sigma < 0{,}5$ dB	$\sigma < 1$ dB	$\sigma < 2$ dB	$\sigma < 0{,}5$ dB	$\sigma < 1$ dB	$\sigma < 2$ dB
2 Hz	2:10	0:48	0:30	14:05	4:10	1:40
4 Hz	1:10	0:30	0:20	7:15	2:20	1:05
8 Hz	0:40	0:20	0:15	3:55	1:25	0:50
16 Hz	0:25	0:15	0:12	2:10	0:55	0:36
31,5 Hz	0:17	0:12	0:11	1:16	0:40	0:30
63 Hz	0:13	0:11	0:10	0:50	0:31	0:26
125 Hz	0:10	0:9	0:09	0:35	0:26	0:24
250 Hz	0:9	0:8	0:08	0:20	0:23	0:22
	Analysis Time up to 16 kHz			Analysis Time up to 160 kHz		

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Table 4.7. Overall measurement times when employing a constant confidence level for 1/3 and 1/1 octave band measurements of random signals without auto-ranging selected

4.5.3. Filter – Common Function No: 202

This function is used to select the appropriate filter bandwidth for 1/3 or 1/1 octave measurements with the 1617. It is stepped using the **Yes** key at the appropriate Set-Up level and in the default condition, is set for 1/3 octave bandwidth.

4.5.4. Frequency – Common Function No: 203

The **Frequency** function determines the centre frequency range over which 1/3 or 1/1 octave measurements are performed with the 1617 and 2636. The **1–Start** and **2–End** parameters accept any value between 2.000000E+00 and 1.600000E+05 (i.e. 2 Hz and 160 kHz), and on default are set to 12.5000E+00 and 160.0000E (i.e. 12,5 Hz and 160 kHz) respectively. Entry of an exact centre frequency value is not necessary, as the 2313 automatically selects the closest 1/3 or 1/1 octave frequency band.

To keep the overall measurement time to a minimum, it is important that a **Start** and **End** frequency band corresponding with the particular frequency range of interest be chosen. This is particularly necessary when operating with an averaging time setting greater than 1 second, as measurement at frequencies outside the frequency range of interest can prolong measurement considerably (see Tables 4.5 and 4.6).

If desired the **Frequency** function can be set so that only a single 1/3 or 1/1 octave band is measured. This is done by setting the **1–Start** and **2–End** parameters to the same centre frequency and is useful in recording a series of measurements, such as for time history readouts, for example. When utilizing an averaging time of 1/2 s or less, single band measurements may be performed at approximately 1,5 s intervals.

4.5.5. Auto-Range – Common Function No: 204

With this function automatic range switching of the **Input** and **Output Section Gain** of the 2636 is possible. It may be used for Leq, as well as 1/3 and 1/1 octave measurements and is enabled by calling on its **1–Active** parameter in the current Operating Set-Up and pressing the **Yes** key. For measurements with manual range selection, the **Auto-Range** function may be disabled by pressing the **No** key at the appropriate Set-Up level.

Input Section Ranging:

Before allowing measurement to commence the **Auto-Range** function sets the **Input** and **Output Section Gain** to their "–30 dB" and "0 dB" settings respectively. It then increases the **Input Section Gain** in 10 dB steps until input overload is detected, whereupon it automatically reduces it by 10, 20, 30 or 40 dB depending on the particular overload margin selected in the Set-Up (see Overload Margin, discussed below). The maximum time for **Input Section Gain** ranging is 10 seconds (i.e. 1,1 s/setting).

Output Section Ranging:

Once a suitable **Input Section Gain** setting is chosen with the **Auto-Range** function, the measurement is started and the readout of the 2636 supervised. If underload or overload is detected or there is less than 35dB between underload and the particular overload margin selected in the Operating Set-Up, the **Auto-Range** function will automatically switch the **Output Section Gain** to a suitable setting. The maximum time for **Output Section Gain** ranging is 1,6 seconds (i.e. 260 ms/setting), which with 1/3 and 1/1 octave band measurements is added directly to the particular averaging time selected and therefore prolongs the overall time for the measurement. With Leq measurements, however, the measurement period is always that specified in the Operating Set-Up. In this case an appropriate warning will be included in the Leq readout which informs of the percentage of the measurement time the 2636 is underloaded or overloaded, e.g.

```
WARNING    overload  in    1.00%  of  measurements
           underload in    0.00%  of  measurements
```

With 1/3 and 1/1 octave measurements only an overload warning is indicated in the readout, e.g. OVERLOAD.

Overload Margin:

To reduce time spent auto-ranging, particularly where signals of continuously changing level are measured or when switching from one filter band to the next, four different overload margins may be chosen. These are "0 - 10 dB", "10 - 20 dB", "20 - 30 dB" and "30 - 40 dB" respectively and refer to the input and output levels below overload where the **Input and Output Section Gain** of the 2636 is switched from one range to the next. They are selected using the **2–Overload margin** parameter of the **Auto-Range** function in the Operating Set-Up and may be stepped from one setting to the next by pressing the **Yes** key at the appropriate set-up level. In the default condition, an overload margin of "10 - 20 dB" is selected.

Note: For measurements requiring use of two simultaneously switched IEC/IEEE controlled 1617 Band Pass Filters, such as for filtering of the noise source and analysis of the received signal, bit 8 of their **PPR Selector** switches should be set to "0" and "1" respectively. This will ensure that only overload detected by the 1617 used for analysis is supervised by the 2313.

4.6. BZ 7005 ERROR CODES

ERROR NO: 0	Paper drive and printing are inhibited. Check that the paper drive compartment is properly closed and that there is sufficient paper fitted to continue operation.

Note: If the paper drive remains inhibited, the alignment of the paper sensor should be checked. See the separate Service Manual for the 2313

ERROR NO: 1	Attempt to alter Default Set-Up No: 0. Is possible with Operating Set-Ups No: 1, 2 and 3 only.
ERROR NO: 2	Attempt to enter clock data outside acceptable limits. Acceptable values are: Year: 1900 to 9999 Month: 1 to 12 Day: 1 to 31 Hours: 0 to 23 Minutes: 0 to 59
ERROR NO: 3	Non existent Set-Up., i.e. Set-Up No: greater than 3
ERROR NO: 4	Non existent Function., i.e. Function No: greater than 204
ERROR NO: 5	Non existent Parameter, i.e Parameter No: greater than that available with the particular function chosen. See Function and Parameter list.
ERROR NO: 6	Parameter value outside limits indicated by accompanying error message.
ERROR NO: 7	Error in character input when using the **Personal Text** function.
ERROR NO: 8	No room for saving measurement in C. Memory. If the measurement is a newly generated one, it may be recalled from the Last Memory. See section 4.3.1.
ERROR NO: 9	Attempt to save measurement exceeding maximum file number of C. Memory. If the measurement is a newly generated one, it may be recalled from the Last Memory. See section 4.3.1.
ERROR NO: 10	Attempt to read V. or C. Memory file (or activate 250 step control sequence) that does not exist. For file listing, activate **Menu** plus either the **V. Memory** or **C. Memory** function.
ERROR NO: 11	No room for saving measurement in V. Memory. If the measurement is a newly generated one, it may be recalled from the Last Memory. See section 4.3.1.
ERROR NO: 12	Attempt to save measurement exceeding maximum file number of V. Memory. If the measurement is a newly generated one, it may be recalled from the Last Memory. See section 4.3.1.
ERROR NO: 13	Not used with BZ 7005.

ERROR NO: 14	Attempt to save measurement in a stored–secured V. or C. Memory file already containing a measurement. If the measurement is a newly generated one, it may be recalled from the Last Memory. See section 4.3.1.
ERROR NO: 15	Attempt to delete a V. or C. Memory file safeguarded by the Delete–Secured function. See sections 4.2.3 and 4.2.7.
ERROR NO: 16	Attempt to activate a function via the IEC interface without first assigning control to the interface of the 2313 or entering the appropriate parameter values for the function. See Chapter 6.
ERROR NO: 17	Error in IEC data. Check that the interface cable used with the 2636 is properly secured.
ERROR NO: 18	Job specification error in data input to the IEC Interface of the 2313., i.e. function or parameter formatting error, when using desk top calculator.
ERROR NO: 19	IEC Time Out. No communication via the IEC interface or communication interrupted for a period lasting 5 seconds or more. Normally indicates minor fault with external equipment and/or connection of equipment not suited for use with BZ 7005. Check all interface cable connections, plus Power and Address Switch settings.
ERROR NO: 20	Attempt to read tape file not originating from the 2313, i.e. measurements recorded without a 2313, cannot be processed by the 2313.
ERROR NO: 21	Tape read error, caused by tape drop out, for example.
ERROR NO: 22	Attempt to read beyond last file present on tape. Normally occurs if non existent tape file named.
ERROR NO: 23	Attempt to save or read beyond end of tape. Read out of the error message is delayed 30 s. This allows data transfer to automatically continue from the beginning of the opposite side of the tape, provided that the tape cassette is taken out and fitted in reverse before the error message is printed.
ERROR NO: 24	Not used with BZ 7005
ERROR NO: 25	No cassette inserted and/or lid of tape compartment not closed
ERROR NO: 26	Substitution of tape file with memory file of the 2313 is not possible because of different file sizes.
ERROR NO: 27	Attempt to overwrite or delete a write–protected tape cassette.
ERROR NO: 28	Attempt to read incomplete tape file, the end of which has been damaged or accidently deleted during manual operation of the 7400.

ERROR NO: 29	Attempt to read a 7400 tape file not containing a soft function. To help locate the correct file, activate **Menu** plus **7400**. See section 4.2.8.
ERROR NO: 30	Not used with BZ 7005
ERROR NO: 31	File substitution not possible due to operating error. Refer to literature for the file substitution option used with the 7400.
ERROR NO: 32	Illegal input to a function or combination of functions. For example, use of Leq file with the Plot function, Simult. file with the List function, Average or Deviation files with the Add, Subtract functions etc.
ERROR NO: 33	Execution of stored pushkey sequence not possible., i.e. sequence contains one or more illegal or non existent functions and parameters.
ERROR NO: 34	Wrong type of memory file for particular function requested. Use of C. Memory file instead of V. Memory file, for example.
ERROR NO: 35	Parameter value outside accepted limits. Press **Help** for details of value entered.
ERROR NO: 36	Execution of function not possible on account of incorrect file series or file interval. For file listing, activate **Menu** and either the **V. Memory** or **C. Memory** function.
ERROR NO: 37 — 500	Not used with BZ 7005.
ERROR NO: 501	For correct operation the "Front" mode must be selected with the 2636 **Interface** keys.
ERROR NO: 502	Incompatible Start Frequency and/or End Frequency chosen with function 203 of the Operating Set-Up. Set Start Frequency to less than, or equal to, the End Frequency, for example.
ERROR NO: 503	Results of addition or subtraction outside accepted limits of –100 to +300 dB.
ERROR NO: 504	Not used with BZ 7005
ERROR NO: 505	Tape file originating from an Application Package other than BZ 7005. Replace BZ 7005 with the appropriate Application Package.

5. USE WITH SIGNAL ANALYZERS TYPES 2032 AND 2034

As with other Application Packages available for the 2313, BZ 7005 is capable of producing hard-copy graphic plots of measurements presented on the display screen of the Dual Channel Signal Analyzers Types 2032 and 2034. Each copy takes approximately 10 seconds to produce and is fully annotated so that there are no control settings to note.

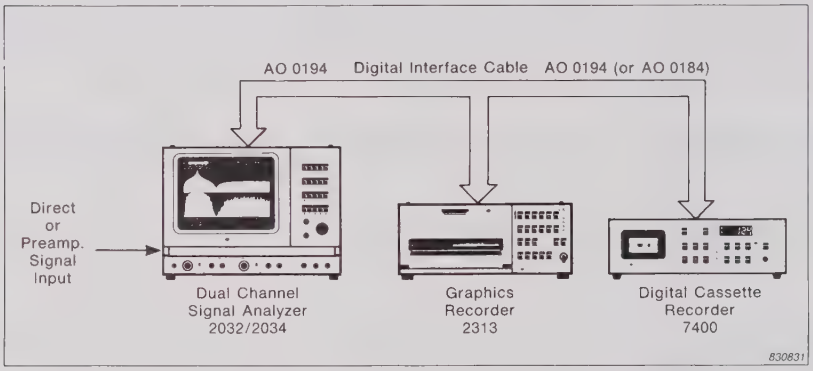

Fig. 5.1. Use of the 2313 Graphics Recorder with a 2032 or 2034 Dual Channel Signal Analyzer plus 7400 Digital Cassette Recorder

Interconnection and initial setting up of the recording and analysis equipment is similar to that described in section 4.1, except that the "Interface Controller – Not Active" mode must be selected using the **Address Switch** of the 2313. This disables local front panel activation of the documentation, storage and measurement functions designed for 2131 Frequency Analyzer, enabling the 2313 to serve as a conventional dot-matrix printer when its **Reset** plus **Exec./Ent.** keys are pressed. A hard copy of the measurement displayed on the 2032 or 2034 may then be obtained simply by pressing the **Digital I/O** "Plot" key on the Analyzer.

By including a 7400 Digital Cassette Recorder in the setup (see Fig.5.1), simultaneous recording and storage of measurements is possible. Alternatively, where it is required to confine readout to only one instrument at a time, then either the 2313 or 7400 may be deactivated by pressing their **Reset** or **Stop** key.

Note: Although 2032 and 2034 **Digital I/O** "Plot" files may be documented using the 2313, they cannot be re-displayed on the 2032 or 2034. For this purpose it is recommended that measurements are recorded using the **Digital I/O** "Output" key of the Analyzers to initiate read out to the 7400.

For further information on the use of the 2032 or 2034 Signal Analyzers, their Instruction Manuals should be consulted.

6. DATA TRANSFER AND REMOTE CONTROL VIA THE IEC INTERFACE

6.1. INTRODUCTION

The digital interface of the Type 2313 is designed according to the standard IEC 625-1 "Interface for Programmable Measuring Apparatus Byte-Serial Bit Parallel". Since the only significant difference between this and the IEEE Standard 488 – 1978/ANSI MC1.1 – 1975 is the type of connector used, compatibility with these standards is only a question of which connecting cable is used. Connection of the Type 2313 to an IEC 625-1 interface bus system is made from the IEC BUS connector on the rear panel of the Type 2313 using cable AO 0194. Connection to an IEEE/ANSI interface bus system is made from the same connector using cable AO 0194 and adaptor AO 0195. Connection to an earlier B & K instrument fitted with a female, slide-lock connector, is made using cable AO 0184. For further details of instrument interconnections, refer to the B & K publication "INTERFACING BRÜEL & KJÆR INSTRUMENTS".

It is important to note that although the Type 2313 interface is designed according to the IEC standard, absolute compatibility with IEC or IEEE/ANSI interfaces designed by other manufacturers cannot be unconditionally guaranteed, since differences can occur within the limits of the specifications. Any problems encountered, however, will be of a software rather than a hardware nature. Where compatibility is in doubt, contact our local representative for details.

6.2. IEC FUNCTIONS IMPLEMENTED

The interface of the Type 2313 implements the following functions, as specified by the IEC standard. The clauses referred to are the relevant sections of the IEC publication specifying the functions. The equivalent sections in the IEEE/ANSI standard are given in parentheses.

Clause 6, Source Handshake (SH) Interface Function, (Section 2,3)
SH 1 — complete capability
Clause 7, Acceptor Handshake (AH) Interface Function, (Section 2,4)
AH 1 — complete capability
Clause 8, Talker (T) Interface Function, (Section 2,5)
T5 — complete capability
Clause 9, Listener (L) Interface Function, (Section 2,6)
L3 — complete capability
Clause 10, Service Request (SR) Interface Function, (Section 2,7)
SR 1 — complete capability
Clause 11, Remote Local (RL) Interface Function, (Section 2,8)
RL 1 — complete capability
Clause 12, Parallel Poll (PP) Interface Function, (Section 2,9)
PP 1 — remote configuration
Clause 13, Device Clear Interface (DC) Function, (Section 2,10)
DC 1 — complete capability

Clause 15, Controller Interface (C) Function, (Section 2,12)

- C1 — system controller
- C2 — send interface clear (IFC) and take charge
- C3 — send remote enable (REN)
- C4 — respond to service request (SRQ)
- C5 — send interface messages, receive control, pass control, pass control to self, parallel poll, take control synchronously

All other functions no capability

For further details of the above functions, refer to the relevant sections of the IEC or IEEE/ANSI standards.

6.3. ADDRESSING THE TYPE 2313

Each device in an IEC interface bus system has at least one listener and/or talker address depending on its function. When an interface controller contacts a device over the IEC interface, it sends a device address, which will contain the appropriate talker or

ASCII Address Characters		ADDRESS SWITCH					Address Code	
Listen	Talk	A5	A4	A3	A2	A1	decimal	octal
SP		0	0	0	0	0	0	0
!	A	0	0	0	0	1	1	1
"	B	0	0	0	1	0	2	2
#	C	0	0	0	1	1	3	3
$	D	0	0	1	0	0	4	4
%	E	0	0	1	0	1	5	5
&	F	0	0	1	1	0	6	6
'	G	0	0	1	1	1	7	7
(	H	0	1	0	0	0	8	10
)	I	0	1	0	0	1	9	11
*	J	0	1	0	1	0	10	12
+	K	0	1	0	1	1	11	13
,	L	0	1	1	0	0	12	14
–	M	0	1	1	0	1	13	15
.	N	0	1	1	1	0	14	16
/	O	0	1	1	1	1	15	17
0	P	1	0	0	0	0	16	20
1	Q	1	0	0	0	1	17	21
2	R	1	0	0	1	0	18	22
3	S	1	0	0	1	1	19	23
4	T	1	0	1	0	0	20	24
5	U	1	0	1	0	1	21	25
6	V	1	0	1	1	0	22	26
7	W	1	0	1	1	1	23	27
8	X	1	1	0	0	0	24	30
9	Y	1	1	0	0	1	25	31
:	Z	1	1	0	1	0	26	32
;	[	1	1	0	1	1	27	33
<	\	1	1	1	0	0	28	34
=	]	1	1	1	0	1	29	35
>	^	1	1	1	1	0	30	36

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Table 6.1. 2313 Address Switch settings (shaded area factory setting)

listener address. This address is in ISO 7-bit code (or equivalent ASCII), bit 8 being unused for addressing, therefore remaining at logic 0. Table 6.1 gives a list of possible ADDRESS SWITCH settings with the corresponding device address in the form of ASCII characters for the different address modes.

Note that in a system where the Type 2313 is a controller, it is not necessary to set the address of the 2313 in order to operate the system. It will, however, be necessary to set the addresses of the other instruments in the system to their factory setting, which can be found in the relevant instruments instruction manual or on the label attached to the Application Package.

6.3.1. Setting the Address Switches

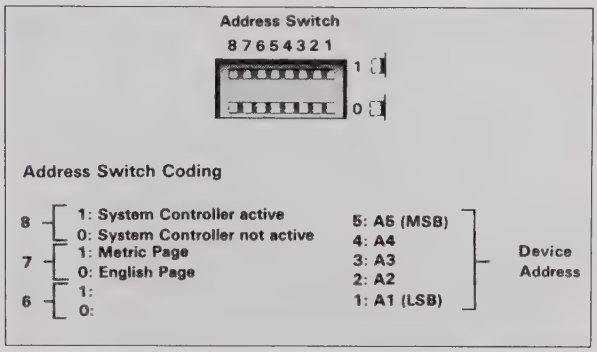

Fig. 6.1. Address Switch on the rear panel of the 2313

The listen and talk addresses over which the 2313 can be contacted via its IEC interface are selected by the **Address Switches** on the rear panel. For each switch pair, depressing the upper switch will give a logic 1 and depressing the lower switch will give a logic 0. The most significant bit (MSB) of the address is given by switch pair A5, while the least significant bit (LSB) is given by switch pair A1.

Switch pair 6 is unused, whilst switch pair 7 is for setting the page size to 'English' or 'Metric'.

Switch pair 8 is for activating or deactivating the 2313 as a system controller. When set at logic 0 ("System Controller not active"), the system controller function of the 2313 is deactivated, which enables the "Listen Only" mode to be activated manually (Section 6.4.1), or enables the 2313 to be operated remotely as described in Sections 6.4 to 6.12. This might imply that the 2313 works as an IEC controller but not as a system controller. However, the functions in the Application Package, as described in Section 1, may still be utilised. When set at logic 1 ("System Controller active"), the system controller function is activated and the 2313 can be used via its front panel pushbuttons to control itself and other instruments depending on the Application Package used (see Section 1). If the 2313 is to be used as a system controller then Sections 6.4 to 6.12 may be ignored.

On delivery, **Address Switch** numbers A1 to A5 on the rear panel of the Type 2313 are set to 00001, and switch pair 8 set to "System Controller active". Other address codes may be selected as required without influencing the operation of the 2313. In a 2313/BZ 7005 system with the Types 1617, 2636 and 7400, it is not necessary to set the address switches A1 to A5 of the 2313.

Note that after activating any of the switches, it is necessary to press "Reset" or power off and then power on again.

6.4. MODES OF OPERATION

The following sections (6.4 to 6.12) require that **Address Switch** 8 is set to "System Controller not active" and that A1 to A5 are set to suit the program of the system controller.

6.4.1. Listen Only Mode

In this mode, the 2313 will print out any data on the interface bus. This mode is accessed manually by pressing **Reset** followed by **Exec./Ent.**

The **Listen**, **Entering** and **Exec./Ent.** LEDs will light, indicating that the 2313 is in the "Listen Only" mode and ready to print data as described in Section 6.12.

Note: To return to the normal remote controllable mode, press Reset manually or clear the 2313 via the interface bus by sending ⟨DCL⟩, ⟨SDC⟩ or ⟨IFC⟩.

6.4.2. Remote/Local Operation

In addition to manual control, the 2313 can be controlled via the interface bus. Three control modes exists:

Local Mode: Some front panel controls can be used by the operator. Full manual control requires that switch 8 is set to "System Controller active" or the 2313 has received the MASTER Job (Section 6.6.3). Avoid using the Set-Up mode except for setting the clock.

Remote Mode: The 2313 can be controlled either remotely, or manually as in local mode.

Remote Mode with Local Lockout: Only remote control is possible, however, it is still possible to carry out a manual Reset.

6.5. THE INTERFACE JOB

Section 6.4.1 describes how to manually bring the 2313 in a mode ready for printing. For remote control over the interface bus, various Jobs can be specified, a list of which is given in Table 6.2.

A general diagram of the Job syntax is given in Fig. 6.2. The 'Job Header' describes the job to be carried out. This consists of one word which may be written in its entirety but may be shortened at least until the underlined part of the word.

Example: PRINTER ⟨LF⟩ or
PRINT ⟨LF⟩ or
PR ⟨LF⟩

will give the same result.

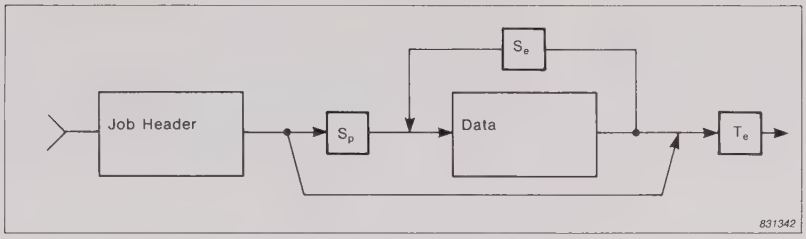

Fig. 6.2. Job syntax diagram

The 'Data', if present, is used to further specify the job. To separate the 'Job' from the Data, a separator S_p is used. Data may be formatted by a Separator S_e. The Job specification ends with a terminator T_e. The following separators and terminator are used:

S_p = ⟨Space⟩

S_e = ⟨ , ⟩

T_e = ⟨LF⟩ or ⟨EOI⟩ with any character.

The character to be sent is the character **between** the brackets – not the brackets themselves. Errors in the job specification will cause the 2313 to send an SRQ (Service Request) if the Service Request function is enabled by the Job specification SRQENABLE (see Section 6.6.11), otherwise an error message will be printed and the 2313 will lock up. After pressing 'Reset' to clear the lock up, the Service Request function will be disabled.

6.6. JOBS IN THE BZ 7005

This Section gives a descripton of each of the Jobs available in the BZ 7005 accompanied by a syntax diagram and an example of a program line. A list of interface Jobs is given in Table 6.2. Note that the word can be shortened up to the underlined part, e.g., 'DEFAULT' can be written as 'D', 'DE', 'DEF', etc.

Interface Job	Section	Interface Job	Section
DEFAULT	6.6.1.	SRQENABLE	6.6.11.
FUNCTION	6.6.2.	SRQDISABLE	6.6.11.
MASTER	6.6.3.	TEST	6.6.12.
NEWSETUP	6.6.4.	TEXT0	6.6.13.
PAGE	6.6.5.	TEXT1	6.6.13.
PRINTER	6.6.6.	TEXT2	6.6.13.
REPEAT	6.6.7.	TEXT3	6.6.13.
RETURNADR	6.6.8.	TEXT4	6.6.13.
SETUP	6.6.9.	TOPPAGE	6.6.14.
SHOWTIME	6.6.10.		

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Table 6.2. List of interface Jobs in alphabetical order

6.6.1. DEFAULT

Sets the current Set-Up parameter values to default (from Set-Up 0).

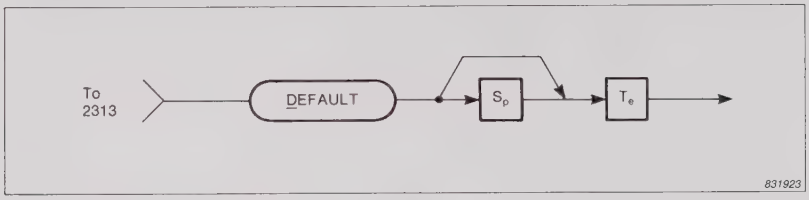

Fig. 6.3. Syntax diagram for changing the current Set-Up to default values

Example of Use:

DEFAULT T_e

6.6.2. FUNCTION

In the preceding chapters, it is described how to use the 2313 functions such as **List**, **Plot** etc. The syntax diagrams in these chapters describe how to select functions and their associated parameters. The same functions and their parameters may be selected via the interface, using other separators between the function and parameter.

No.	Main Function Name
0	List
1	Plot
2	Memory
3	Cont. Memory
4	7400
5	L_{eq}
6	Delete
7	Memory Menu

No.	Extended Function Name
111	Execute 7400 Program
112	Store 7400 Program
119	Calibrate
120	Relay on
121	Relay off
122	Set Unit Index*

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* see text

Table 6.3. List of BZ7005 main and extended functions selectable over the interface using the given function number

No.	Sub-function Name
1	*Last*
2	*Memory*
3	*C. Memory*
4	*7400*
5	L_{eq}
17	*Average spectra*
18	*Deviation spectra*
19	*Add Spectra*
20	*Simultaneous*
21	*Sub. Spectra*
22	*Time history*

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Table 6.4. List of BZ7005 sub-functions selectable over the interface using the given sub-function number

Fig. 6.4 gives a general syntax diagram to activate one of the BZ 7005 functions listed in Table 6.3. The sub-functions are listed in Table 6.4, where the no. in brackets is used when accessing the sub-function in the Set-Up. Note, however, that sub-function numbers 6 and 7 cannot be accessed in the Set-Up for the BZ 7005 package. Detailed information on parameters can be found in the description of the actual function in the previous sections. As an example, a syntax diagram of the function 'List', is given in Fig. 6.5.

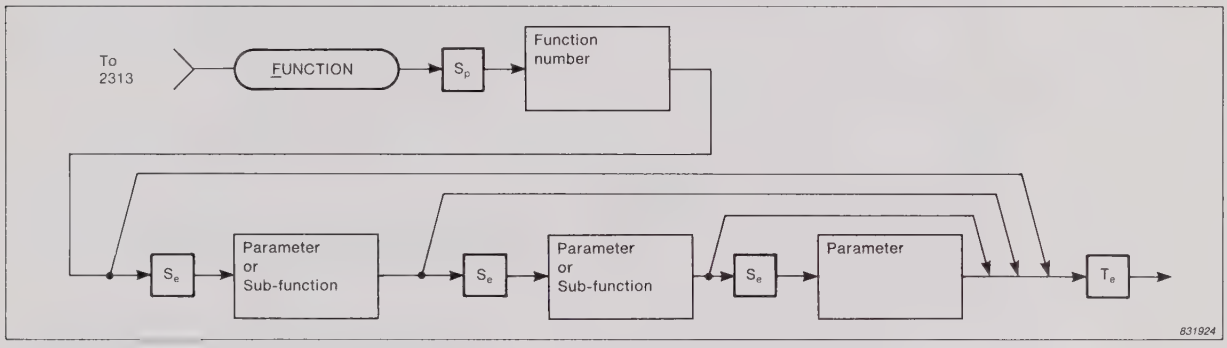

Fig. 6.4. General syntax diagram for activating one of the 2313 functions

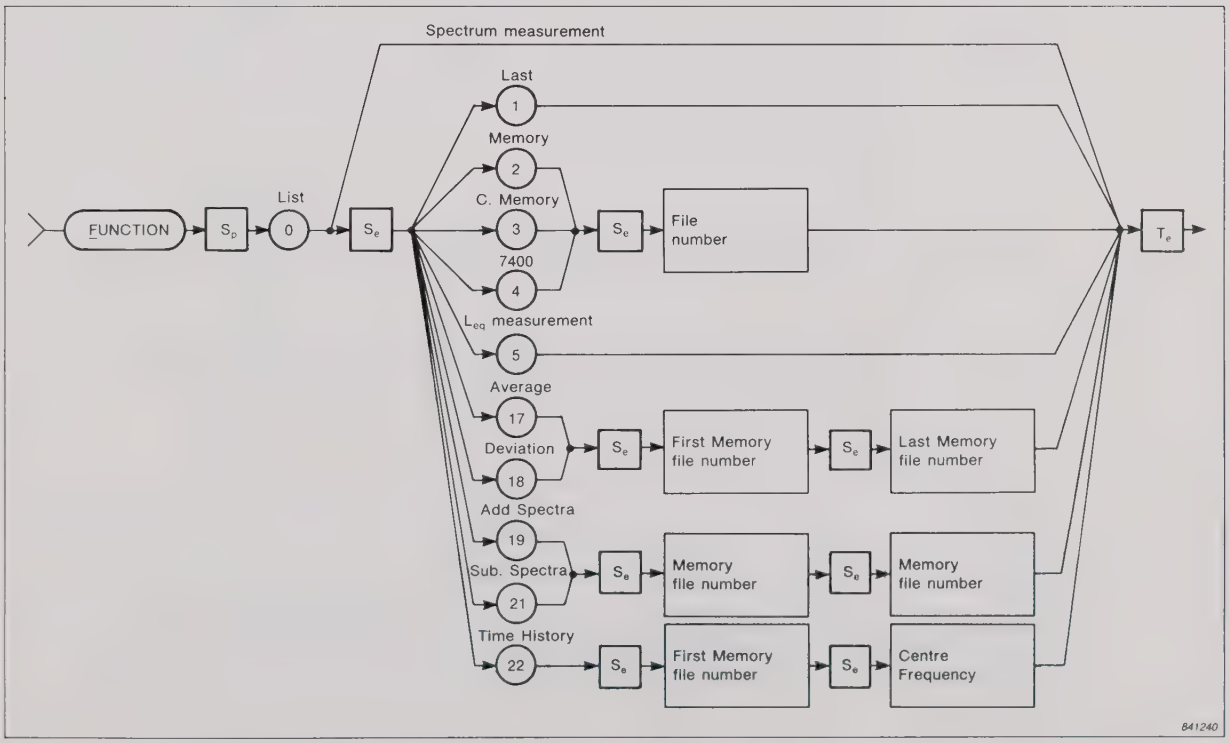

Fig. 6.5. Syntax diagram for activating the 'List' function

Examples of Use:

RETURNADR R T_e	
FUNCTION 1 , 17 , 3 , 8 T_e	Enables the Plot function
〈TCT〉	The control character commands the 2313 to take control

This example will result in plotting of an average of the files from 3 to 8 inclusive.

FUNCTION 122 , 204 , 2 , 3 T_e	Sets the Unit field for the Autorange overload margin to '30 – 40 dB'
〈TCT〉	The control character commands the 2313 to take control

Notes:

Function no. 122 in Table 6.3 is used for setting the UNIT field in the Set-Up and can only be accessed over the interface.

The system controller must not operate the 2313 until the function is executed and the 2313 has passed the control back to the system controller. See Section 6.7 for further information on passing control.

The 2313 gives up control on completion of the function, therefore this Job should be preceded by RETURNADR (Section 6.6.8). The selected 2313 function will be initiated on passing control to the 2313.

6.6.3. MASTER

Allows the 2313 to be controlled manually using the front panel pushkeys (or remote terminal — see Chapter 7).

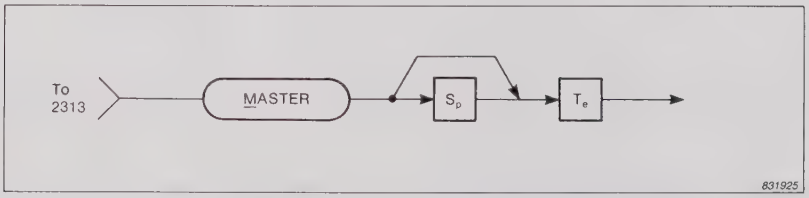

Fig. 6.6. Syntax diagram for controlling the 2313 via the front panel

Example of Use:

MASTER T_e	
〈TCT〉	The system controller passes control to the 2313.

Notes:

This Job should be followed by passing control of the bus to the 2313, see Section 6.7. Control is released when 'Reset' is activated. The system controller may take control by sending 〈IFC〉.

6.6.4. NEWSETUP

Specifies which of the 4 Set-Ups is to be the current Set-Up.

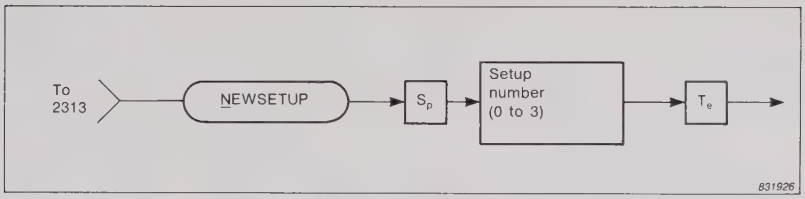

Fig. 6.7. Syntax diagram for selecting current Set-Up

Example of Use:

NEWSETUP 2 T_e Selects Set-Up number 2 to be the current Set-Up

6.6.5. PAGE

The remainder of a page will be fed.

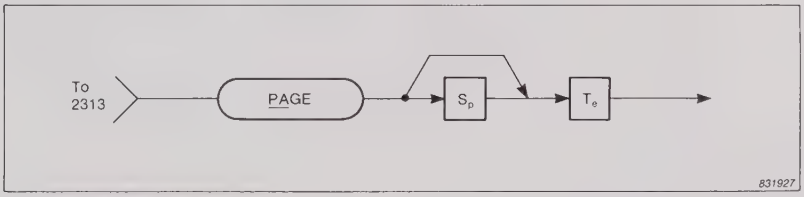

Fig. 6.8. Syntax diagram for paper feed of the remainder of the page

Example of Use:

PAGE T_e

Notes:

The page size is determined by the setting of the **Address Switch** pair 7.

6.6.6. PRINTER

Brings the 2313 to work in a printer mode as described in Section 6.12.

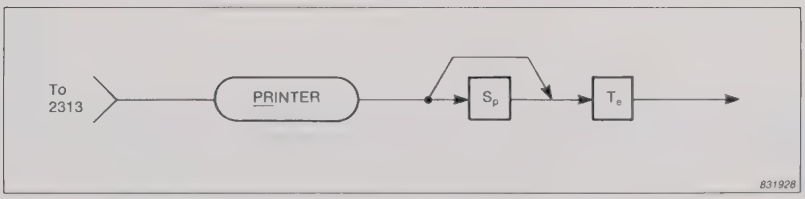

Fig. 6.9. Syntax diagram for selecting printer mode

Example of Use:

PRINTER T_e

Notes:

Once set, the 2313 will remain in the printer mode until cleared remotely (Section 6.11), or by pressing **Reset** on the front panel.

6.6.7. REPEAT

Repeats the previously executed FUNCTION or TEST. Has the same effect as pressing **Exec./Ent.** in manual mode.

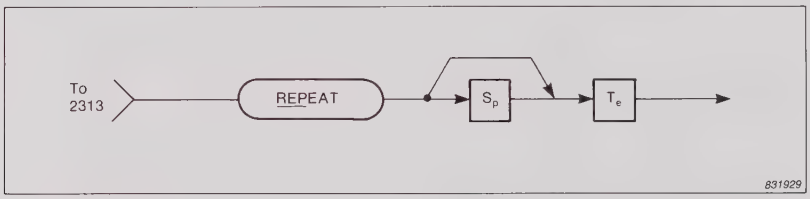

Fig. 6.10. Syntax diagram for repeating previous FUNCTION or TEST

Example of Use:

RETURNADR S T_e
REPEAT T_e
〈TCT〉

The control character 〈TCT〉 commands the 2313 to take control.

Notes:

See Section 6.7 for further information on passing control.

The 2313 gives up control on completion of the function, therefore this Job should be preceded by RETURNADR (Section 6.6.8). The selected 2313 function must be started by passing control to the 2313.

The system controller must not operate the 2313 until the repeated function is executed and the 2313 has passed the control back to the system controller. This time depends heavily on the repeated function.

6.6.8. RETURNADR

Specifies the address to which control should be returned on completion of a function which requires that the 2313 has control over the interface. This specification must always precede the following jobs: FUNCTION, MASTER, REPEAT, TEST.

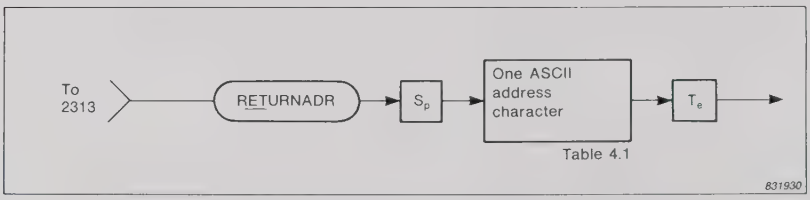

Fig. 6.11. Syntax diagram for specifying return address

Example of Use:

RETURNADR U T_e	Enables control to be returned to a system controller with an address corresponding to the ASCII character 'U' (decimal 85)

Notes:

This return address will be remembered by the 2313 until the 2313 is cleared by ⟨DCL⟩, ⟨SDC⟩ or in the case of an aborted function by ⟨IFC⟩.

6.6.9. SETUP

Enables new parameter values to be added to the current Set-Up.

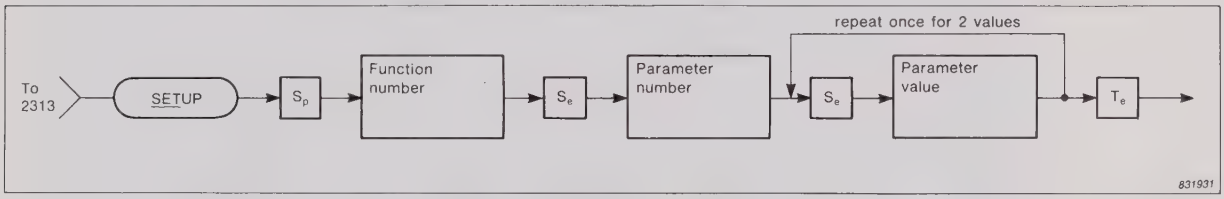

Fig. 6.12. Syntax diagram for changing Set-Up values

Example of Use:

SETUP 1 , 3 , 500 T_e	Plot from 500 Hz
Wait	
⟨SDC⟩	
SETUP 2 , 1 , 3 , 12 T_e	Memory 3 to 12 store-secured
Wait	
⟨SDC⟩	
SETUP 119 , 2 , 120 T_e	Calibrate, set level to 120 dB
Wait	
⟨SDC⟩	
SETUP 17 , 1 , 0 T_e	Average not arithmetical Hz
Wait	
⟨SDC⟩	
SETUP 204 , 1 , –1 T_e	Autorange is active
Wait	
⟨SDC⟩	

Notes:

Note the necessity of sending an ⟨SDC⟩ or a ⟨DCL⟩ after each Set-Up command. After the SETUP command and before the clear, a wait of 20 msec. is necessary. A check as described in Section 6.7 and 6.8 may be performed.

From the list in Fig. 6.13 of the BZ 7005 functions, one can obtain function numbers, parameter numbers and values. This list contains default values i.e. from Set-Up 0. Note that it is not possible to change the UNIT field of the setups 1 to 3 with the SETUP function, instead use function no. 122 (see Section 6.6.2).

The parameter values **Yes** and **No** are selected by writing –1 for **Yes** and 0 for **No**.

To select another Set-Up, use NEWSETUP (Section 6.6.4).

```
SELECTED SETUP NO.: 0
   FUNCTION              PARAMETER                      VALUE        UNIT
 0 List                  1 List from                :  12.5000E+00   Hz
 0 List                  2 List to                  : 160.0000E+03   Hz
 0 List                  3 Including head           : YES
 1 Plot                  1 Graphic offset           :       0        dB
 1 Plot                  2 Scale proportion, 25dB/  :       5        cm
 1 Plot                  3 Plot from                :  12.5000E+00   Hz
 1 Plot                  4 Plot to                  : 160.0000E+03   Hz
 2 Memory                1 Store-secured            :      -1       -1
 3 Cont. memory          1 Store-secured            :      -1       -1
 5 Leq                   1 Leq duration time        :       0
 5 Leq                   2 Leq duration time        :       1
 5 Leq                   3 Leq duration time        :       0
 5 Leq                   4 Standard A weight        : YES
 6 Delete                1 Memory secured           :      -1       -1
 6 Delete                1 Cont. memory secured     :      -1       -1
(/100) 110 Personal text 1 Enable line 0            : NO
(/100) 110 Personal text 2 Enable line 1            : NO
(/100) 110 Personal text 3 Enable line 2            : NO
(/100) 110 Personal text 4 Enable line 3            : NO
(/100) 110 Personal text 5 Enable line 4            : NO
(/109) 119 Calibrate     1 Active                   : NO
(/109) 119 Calibrate     2 Set level to             :      94        dB
(/109) 119 Calibrate     3 Cal. offset:             :   0.0000E+00   dB

SUBFUNCTIONS:
 17 Average spectra      1 Arithmetical             : YES
 18 Deviation spectra    1 Arithmetical             : YES
 19 Add spectra          1 Arithmetical             : YES
 21 Sub. spectra         1 Arithmetical             : YES
 22 Time history         1 Number of files          :      39

COMMON SETUP:
200 Add Lin and W        1 Weighting                : No weight channel  ◀
201 Averaging            1                          :  1/2s              ◀
202 Filter               1                          : 1/3  octave        ◀
203 Frequency            1 Start                    :  12.5000E+00   Hz
203 Frequency            2 End                      : 160.0000E+03   Hz
204 Autorange            1 Active                   : NO
204 Autorange            2 Overload margin          : 10 - 20dB          ◀
```

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Fig. 6.13. 2313 listing of BZ 7005 functions with function numbers, parameters with parameter numbers and default values

6.6.10. SHOWTIME

Results in a print-out of date and time.

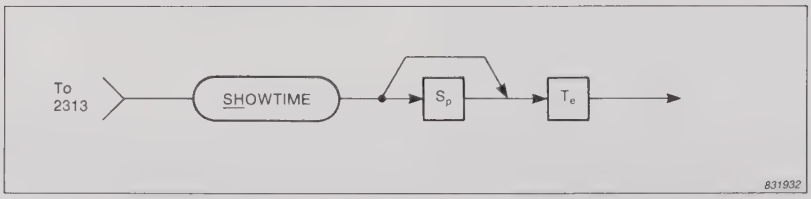

Fig. 6.14. Syntax diagram for read-out of date and time

Example of Use:

SHOWTIME T_e

6.6.11. SRQENABLE
SRQDISABLE

SRQENABLE enables the 2313 to send out a service request (SRQ) in case of a Job specification error, an error during the Job, or lack of paper.

SRQDISABLE disables the 2313 from sending out a service request.

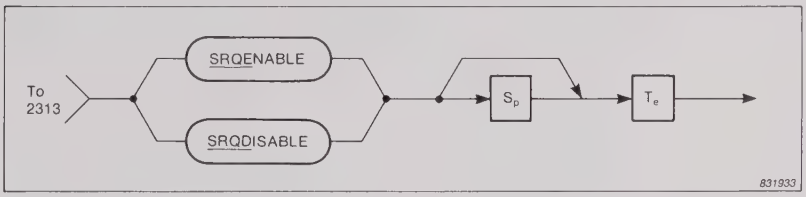

Fig. 6.15. Syntax diagram for SRQ enabling and disabling

Example of Use:

SRQENABLE T_e

Notes:

When an error occurs, the 2313 will lock until a serial poll has been carried out (see Section 6.10), or until the 2313 is cleared (See Section 6.11).

6.6.12. TEST

Carries out a test of the 2313 and gives a print-out for inspecting the printer head quality.

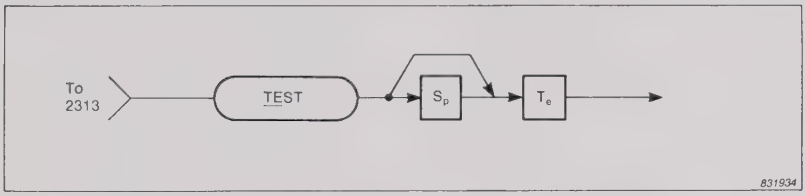

Fig. 6.16. Syntax diagram for 2313 self-test

Example of Use:

RETURNADR W T_e
TEST T_e
〈TCT〉 The control character 〈TCT〉 commands the 2313 to take control

Notes:

See Section 6.7 for further information on passing control.

This command must be preceded by RETURNADR (Section 6.6.8), for returning control on completion of the test, and control should be passed to the 2313 in order to start the test. The system controller must not operate the 2313 until the test is finished and the 2313 has passed control back to the system controller (approx. 3 minutes).

6.6.13. TEXT0
TEXT1
TEXT2
TEXT3
TEXT4

Inserts text in the relevant textline.

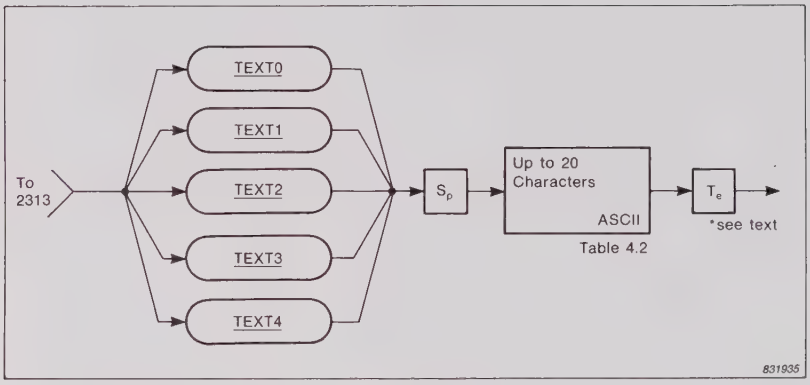

Fig. 6.17. Syntax diagram for inserting text in the read-out textlines

Example of Use:

TEXT0 1/3 Octave Spectrum 〈EOI〉 Inserts '1/3 Octave Spectrum' in textline 0 (top textline)

Notes:

* 〈EOI〉 with the last character should be used as T_e and not 〈LF〉. If, however, the control characters including 〈LF〉 are used, then the special characters from Table 6.6 will appear in the text field, e.g., 〈LF〉 would give a ^{0}.

Each textline contains a maximum of 20 characters.

6.6.14. TOPPAGE

The current position will be defined as the top of page.

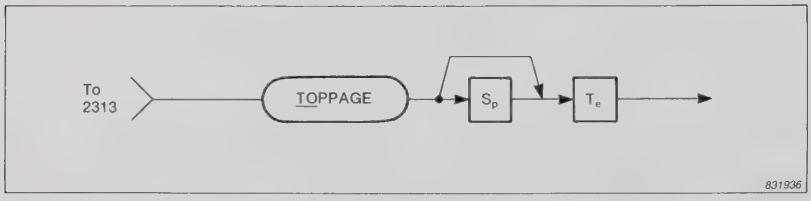

Fig. 6.18. Syntax diagram for setting the current position to top of page

Example of Use:

TOPPAGE T_e

6.7. CHECKING THE JOB SPECIFICATION

During the development phase of the control program, it will be useful to know whether the job specifications sent to the 2313 are correct. In this case, the system controller must look for a Service Request ⟨SRQ⟩ message on the bus, (if service request is enabled), until the 2313 has checked the message.

It is important that the Take Control ⟨TCT⟩ message, if relevant, is not sent until the check is finished, as it is impossible for the system controller to perform a serial poll after it has passed the control to the 2313.

6.8. CHECKING FOR JOB ERRORS

Even if the job specification syntax is correct, the parameter numbers or values may be wrong.

While waiting for the 2313 to carry out its job, look for a possible service request ⟨SRQ⟩ message from the 2313.

Note that errors detected by the 2313 while having the IEC control, will lock the 2313 and can therefore not be investigated by the system controller. Such errors require an interface clear ⟨IFC⟩ which must be sent by the system controller after it has waited unsuccesfully for the job to finish. However, if the error is due to lack of paper, the 2313 will not lock but will send a service request ⟨SRQ⟩ message, if enabled, after it has completed the job.

6.9. ERRORS BY REMOTE CONTROL

Some typical errors which can occur are:

1. Forgetting to specify the return address for the system controller when required will result in:

   Job specification error Error No.: 18

2. Forgetting to pass control to the 2313 when required gives after about 5 seconds:

   IEC timeout Error No.:19

3. Misspelling job specifications gives:

   Job spec. error Error No.:18

4. Operating the system controller before the 2313 has passed the control back to the system controller will probably result in an error message from the system controller.

5. Wrong parameter no. or value used in SETUP gives various Error print outs — see error list in section 4.6.

For error printouts other than mentioned here please see the error list in section 4.6.

6.10. POLLING THE STATUS OF THE 2313

If the Service Request function is enabled (see Section 6.6.11), an error will cause an SRQ (Service Request signal — see Section 6.7 and 6.8). To locate the device asking for service and to get information about the cause of the error, a serial poll can be carried out by the system controller. The status byte of the 2313, read by the system controller carries the information stated in Table 6.5.

Bit No.	Status Message
8	*(not used and set false i.e. 0)*
7	2313 is asking for service
6	2313 is in an abnormal condition
5	2313 is busy carrying out a job
4	2313 is out of paper
3	*(not used and set false i.e. 0)*
2	2313 has detected a Job error
1	2313 has detected a Job specification error

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Table 6.5. Table of 2313 Status Messages

At the same time as bit 4 is set the 2313 will print:

Printing not allowed – Do check paper roll ERROR NO.: 0

If bit 1 is set, the 2313 will print:

Job specification error ERROR NO.: 18

and if bit 2 is set, the 2313 will print an Error No. other than 18 — refer to Error Code list.

A serial poll will clear this error condition if service request is enabled, otherwise a clearing by 〈DCL〉 or 〈SDC〉 has to be carried out (See Section 6.11).

Another method of polling the 2313 is the Parallel Poll. After the polling sequence is made by the system controller, a parallel poll will give the same information as bit 5 in the serial poll status byte. If an error is detected by Parallel Poll, a clearing by 〈DCL〉 or 〈SDC〉 must be carried out.

6.11. CLEARING THE 2313 VIA THE BUS

Device Clear 〈DCL〉 or Selected Device Clear 〈SDC〉:

A Reset of the 2313 will be made clearing print buffer and job specification buffer as well as a running job. Stored memory files and interface functions will not be cleared.

Interface Clear 〈IFC〉:

If the 2313 has been manually brought to the 'printer' mode, the 〈IFC〉 will cause both a Reset as for a 〈DCL〉 and a reset of the interface functions. The same will be the result if the 2313 is locked by an error while having the IEC control.

If the 2313 previously has been remotely operated without locking by errors, then only the interface functions will be reset.

If a job requires that the 2313 has control over the bus, an 〈IFC〉 must not occur until the 2313 has finished its job and has given the control back to the system controller in an orderly way except in the case of a locking error.

Note: To ensure that a job will be executed, it is necessary to wait a certain time between job specifications and while the 2313 is being cleared.

6.12. PRINTING WITH THE 2313/BZ 7005

The following procedure for printing data transferred over the interface bus applies when the 2313 is in its 'printer' (or listen only) mode. This can be achieved manually as outlined in Section 6.4.1 or by addressing the 2313 and sending the job specification PRINTER as described in Section 6.6.6. The 2313 will then be in its 'printer' mode, accepting ASCII characters sent over the interface bus and printing them out on receipt of 〈LF〉 (Line Feed), 〈EOI〉 (End Or Identify), or when the 2313's buffer is full. Characters are stored in sequence in the buffer and are printed out with automatic line feeds inserted in case of overflow.

By sending the appropriate command, given overleaf, the ASCII printer format can be altered, or the 2313 brought into its graphic mode. The 2313 can be unaddressed to isolate it from interface bus activity, however when re-addressed, the 2313 will remain in its 'printer' mode. Deactivating the 'printer' mode is achieved by sending DEVICE CLEAR or SELECTED DEVICE CLEAR (see Section 6.11), or by manually activating any of the Reset levels (see Section 3.4).

The 2313 can print out all the non-control ISO characters as well as a range of special characters after receiving the ISO control character 〈SO〉 (see below). The range of control characters and their influence on the 2313 when in the 'printer' mode are listed below:

〈LF〉 Produces a line feed i.e. the current line is terminated and a new line started.

〈FF〉 Produces a form feed i.e. the current page is terminated and a new page started.

〈SO〉 The ISO characters between decimal 64 and 95 are replaced by special characters as shown in Table 6.6. This is maintained as long as the 2313 is in the 'printer' mode or until 〈SI〉 is sent.

〈SI〉 Returns the standard ISO character set if previously changed by sending 〈SO〉.

〈ESC〉 Notifies the 2313 of the start of a sequence, terminated by a ':', to change the printer format in 'printer' mode, or to access the graphic mode (see Sections 6.12.1 and 6.12.2).

The use of ⟨SO⟩, ⟨SI⟩ and ⟨ESC⟩ sequences conform to ISO 2022 (Code Extension Techniques).

Bit Numbers b_4 b_3 b_2 b_1	b_8 b_7 b_6 b_5 0 0 0	0 0 1	0 1 0	0 1 1	0/1 1 0 0	0/1 1 0 1	1 1 0	1 1 1
0 0 0 0	NUL	DLE	SP	0	@ / Δ	P / π	`	p
0 0 0 1	SOH	DC1	!	1	A / α	Q / ∫	a	q
0 0 1 0	STX	DC2	"	2	B / 2	R / æ	b	r
0 0 1 1	ETX	DC3	#	3	C / Σ	S / σ	c	s
0 1 0 0	EOT	DC4	$	4	D / δ	T / τ	d	t
0 1 0 1	ENQ	NAK	%	5	E / ϵ	U / ü	e	u
0 1 1 0	ACK	SYN	&	6	F / φ	V / √	f	v
0 1 1 1	BEL	ETB	'	7	G / ω	W / –	g	w
1 0 0 0	BS	CAN	(	8	H / Ω	X / ↑	h	x
1 0 0 1	HT	EM	)	9	I / o	Y / ↓	i	y
1 0 1 0	LF	SUB	*	:	J / o	Z / →	j	z
1 0 1 1	VT	ESC	+	;	K / Ø	[/ ←	k	{
1 1 0 0	FF	FS	,	<	L / λ	\ / –	l	¦
1 1 0 1	CR	GS	–	=	M / μ	] / –	m	}
1 1 1 0	SO	RS	.	>	N / ±	^ / ¦	n	~
1 1 1 1	SI	US	/	?	O / ■	– / ¦	o	DEL

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Table 6.6. Table of ASCII (ISO 646 equivalent) characters showing also the special characters available on the 2313

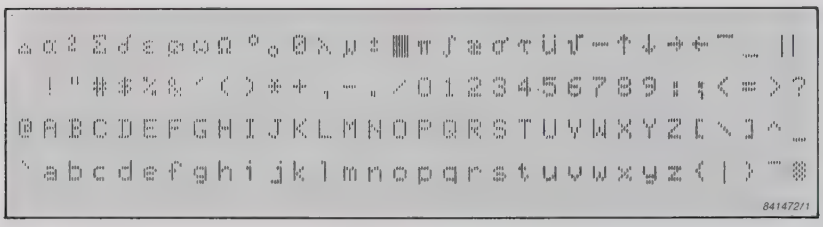

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Fig. 6.19. Sample print out from the 2313 showing the alphanumeric characters available

6.12.1. Changing the Printer Format in 'Printer' Mode

Each standard character occupies a space of 8 pixels high by 6 pixels wide. The character height, distance between characters and line spacing can be altered as well as adding an underline. Fig. 6.20 gives the syntax of the sequence used to alter the format. The character height is a number between 1 and 4 (default is 2), where 1 is 1/2 of the standard height, 3 is 3/2 times the standard height etc. The space between characters is between 0 and 5 pixels (default is 0). The space between lines is between 0 and 7 pixels (default is 2). The underline feature underlines the following line only and is cancelled on receipt of ⟨LF⟩.

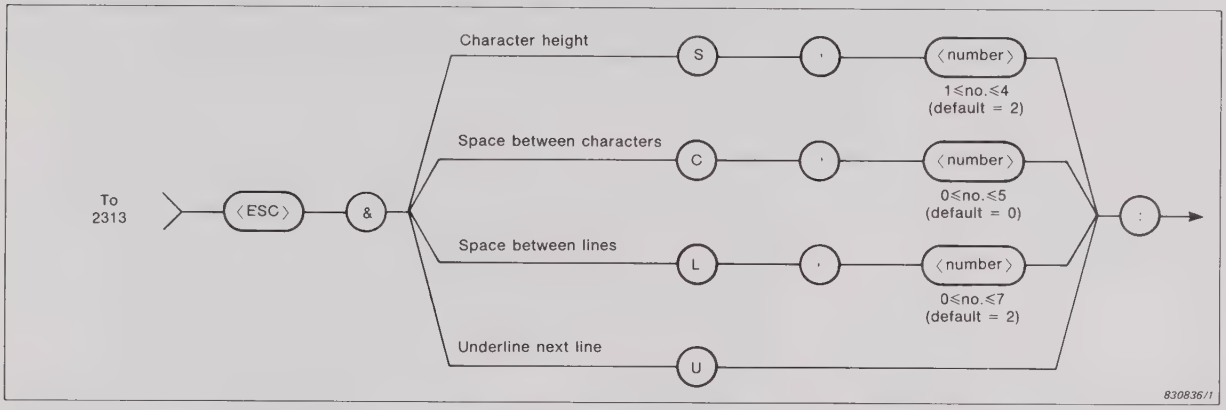

Fig. 6.20. Syntax diagram for altering the standard character format

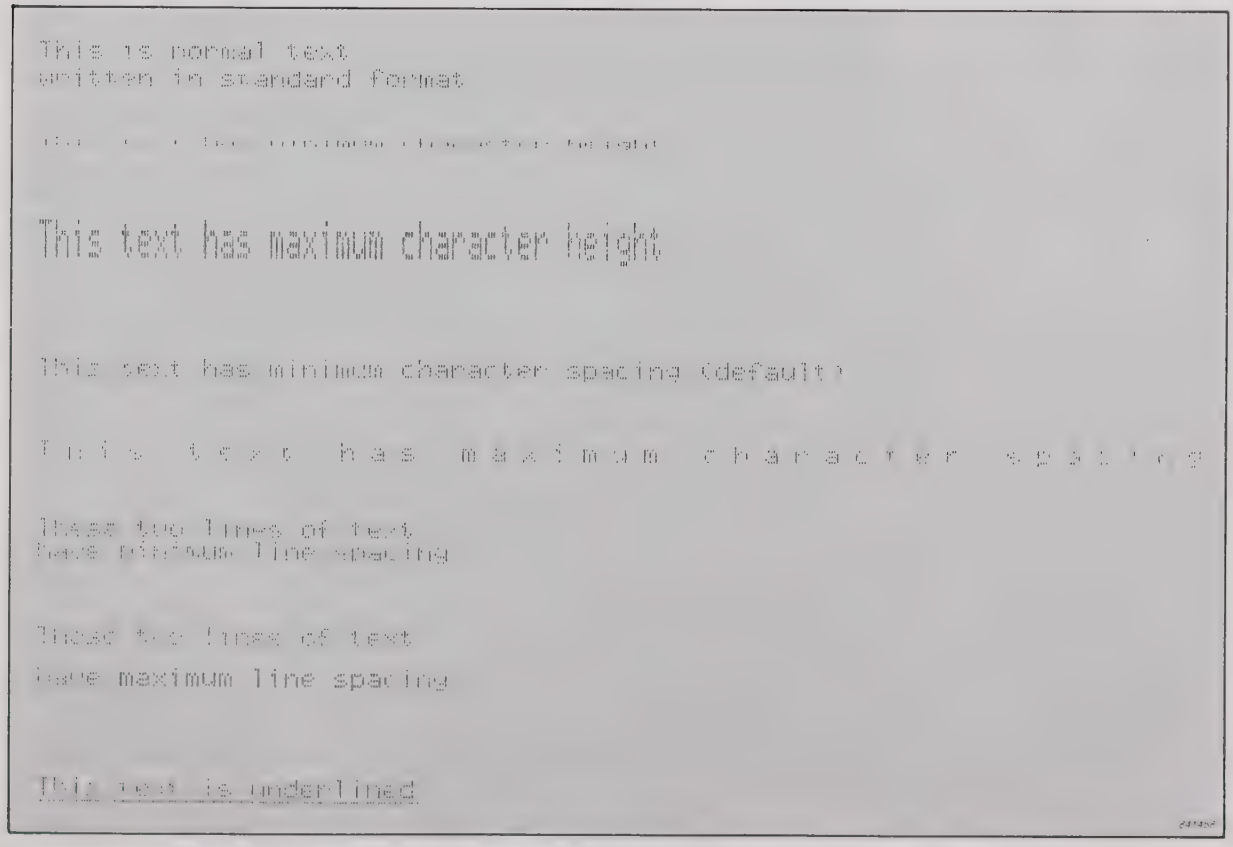
This is normal text
written in standard format
This text has maximum character height
This text has minimum character spacing (default)
These two lines of text
have minimum line spacing
These two lines of text
have maximum line spacing
This text is underlined

Fig. 6.21. Sample print out from the 2313 showing various format possibilities

6.12.2. Changing to Graphic Mode

In the graphic mode, the binary data sent to the 2313 activate the pixels directly. Fig. 6.23 gives the syntax used when printing in graphic mode with an example of the construction of one graphic line given in Fig. 6.22. This specifies what binary data follows this ⟨ESC⟩ sequence and it is important that the following data is as specified. On completion of the graphic print-out, the 2313 returns to the normal ASCII mode. At this point and not before, a further ⟨ESC⟩ sequence can be initiated. The number of graphic lines is from 1 to 999 (default of 1). The number of graphic bytes per line is from 1 to 64 (default of 64 which is one complete line). The Graphic line start point is from 0 to 63 (default is 0 i.e. start at first line). Fig. 6.24 gives an example of a program, written for demonstrating the graphic mode. An example of the print-out obtained from this program is given in Fig. 6.25.

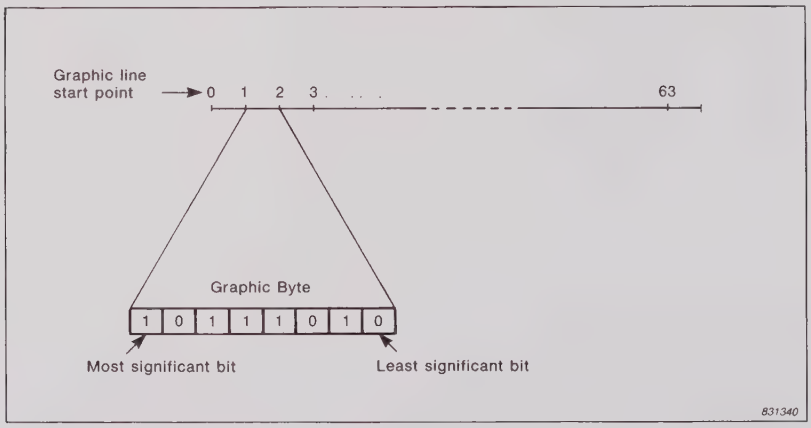

Fig. 6.22. Example of the construction of one graphic line

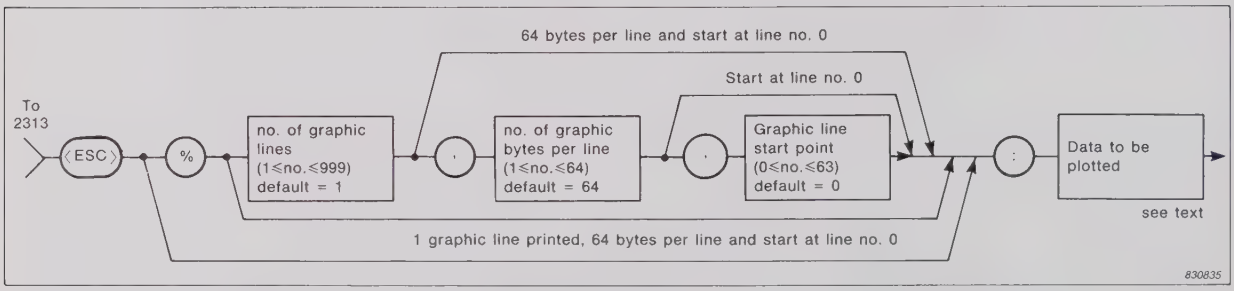

Fig. 6.23. Syntax diagram for plotting in the graphics mode

```
10    !
20    ! The following program reads in 30 values and generates a graphic
30    ! picture on the 2313 showing the values as a histogram.
40    !
50    ! The program is written on an HP 9826 with BASIC 2.0 System.
60    !
70    ! 2313 should be set to 'System Controller, Not Active' mode and the
80    ! address should be set to decimal 1.
90    !
100   !
110   COM Hist(1:30)                    ! The array 'Hist' is used for data.
120   INTEGER Pixel_array(0:200,1:30)
130   !
140   ! The array 'Pixel_array' is used to store 201 pixel-lines of 30 graphic
150   ! bytes (240 bits). Each graphic byte represents one channel and is
160   ! stored as INTEGER's.
170   !
180   Min=1.E+9
190   Max=1.E-9
200   !
210   ! Read in data from keyboard:
220   !
230   FOR Ch=1 TO 30
240     DISP 'VALUE CHANNEL";Ch;
250     INPUT Hist(Ch)
260     IF Hist(Ch)>Max THEN Max=Hist(Ch)   ! Find maximum
270     IF Hist(Ch)<Min THEN Min=Hist(Ch)   ! Find minimum
280   NEXT Ch
290   !
300   Range=Max-Min       Autoscaling
310   Plot_range=200      200 pixel-lines are used for data
320   All_pixels=255      All 8 bits in one graphic byte is 1
330   No_pixels=0         All 8 bits in one graphic byte is 0
340   First_pixel=128     First bit (most significant bit) is 1
350   Last_pixel=1        Last bit (least significant bit) is 1
360   !
370   ! Generate the top frame line:
380   !
390   FOR Ch=1 TO 30
400     Pixel_array(200,Ch)=All_pixels  ! Set all  8 bits in the byte to 1
410   NEXT Ch
420   !
430   ! Generate the data lines from top to bottom:
440   !
450   FOR Line=199 TO 1 STEP -1
460     FOR Ch=1 TO 30
470     IF Hist(Ch)-Min>=(Plot_range-Line)*Plot_range/Range THEN
480       Pixel_array(Line,Ch)=All_pixels                ! Set all 8 bits to 1
490     ELSE
500       Pixel_array(Line,Ch)=No_pixels                 ! Set all 8 bits to 0
510       IF Ch=1 THEN Pixel_array(Line,Ch)=First_pixel  ! Set left frame bit
520       IF Ch=30 THEN Pixel_array(Line,Ch)=Last_pixel  ! Set right frame bit
530     END IF
540     NEXT Ch
550   NEXT Line
560   !
570   ! Generate the bottom frame line:
580   !
590   FOR Ch=1 TO 30
600     Pixel_array(0,Ch)=All_pixels  ! Set all 8 bits in the byte to 1
610   NEXT Ch
620   !
630   CLEAR 701                       ! Clear 2313
635   WAIT .5                         ! Wait for execution
640   OUTPUT 701;"PRINTER"            ! Set 2313 in printer mode
650   OUTPUT 701;CHR$(10);CHR$(10)    ! Send 2 Line Feeds
660   !
670   ! Print text:
680   !
690   OUTPUT 701;"                              PRINT: Hist"  ! Optional
700   !
710   ! Dump the pixel array to the printer:
720   !
730     No. of bytes : 30
740   ! No. of lines per byte: 1
750   ! Start point for dump: 1
760   !
770   OUTPUT 701 USING "#,K,#030(B)";CHR$(27)&"X201,                    ! Dump
780   !
790   !
800   ! Print text:
810   !
820   OUTPUT 701;CHR$(13);
0";CHR$(10);CHR$(10)
830   !
840   END
```

Fig. 6.24. Example of a program to demonstrate the graphic mode of the 2313

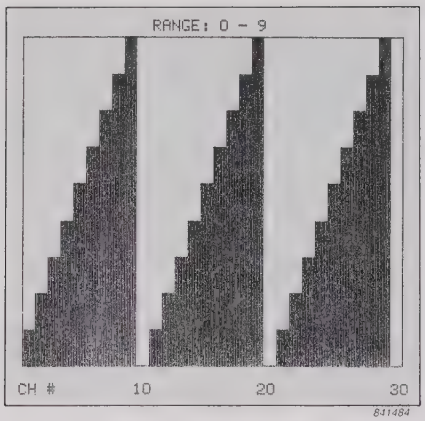

Fig. 6.25. Read-out obtained when running the program example in Fig. 6.24

7. THE SERIAL INTERFACE

7.1. INTRODUCTION

The Serial Interface in the 2313 conforms to the EIA Standard RS–232C (equivalent to CCITT V.24). This standard ensures voltage level compatibility, identical pin wiring, and that certain control information supplied by one device can be understood by other devices. However, it is important to note that the interface may be used in various ways and that it is allowed to use more or less simple subsets of the standard.

To operate the interface is not only a matter of sending understandable data between the devices, but also to ensure that the device uses the number of control lines which is needed by the other device, that the number of bits and stop bits is correct and that the same baud rate, (data flow in bits per second), is selected in the two devices.

The following specifications apply to the Serial Interface of the 2313:

Number of bits: 8
Number of stop bits: 2
Parity: No
Mode of operation: Full duplex
Baud rate: 75 – 9600 Baud
Output level: ± 7 Volt nominal
Connector: 25-pin female
Synchronization method: None

The 2313 is coupled as a "Data Communication Equipment (DCE)" which is also called a modem. The device which is connected to the 2313 will normally be a "Data Terminal Equipment (DTE)" and have a 25-pin male connector. The baud rate may be selected up to 9600 baud, but in cases where a block of more characters are following rapidly after each other, it may be advisable to use a lower baud rate.

List of pins used:

1.	Protective ground	connected for chassis
2.	TDATA	Data **to** the 2313 (input)
3.	RDATA	Data **from** the 2313 (output)
5.	CTS	Clear to send (output)
6.	DSR	Data set ready (output)
7.	Signal Ground	Common return
8.	DCD	Data carrier detect (output)
20.	DTR	Data terminal ready (input)

The signals CTS, DSR and DCD are held true (high level) whenever the 2313 is turned on. The signal DTR is expected to be true but may in most cases be left unconnected. Consult the manual for the Data Terminal Equipment for possibly needed control signals.

7.1.1. Setting the 2313 Baud Rate

When a terminal is connected to the 2313 via its RS–232C interface and 'Reset' pressed, it is possible to insert personal text via the terminal or to remotely control the 2313. Before operating the terminal it may be necessary to set the baud rate to match that of the 2313 (factory set to 9600 bits/sec.). If necessary, the 2313 baud rate can be altered in multiples of 2 from 9600 to 75 bits per second, by altering the jumper plug to a new position as shown in Fig.7.1. The jumper plug is located on the printed circuit board on the inside of the back panel, accessible by removing the two screws securing the top panel and sliding the panel back. Ensure the mains power is disconnected before attempting to remove the top panel.

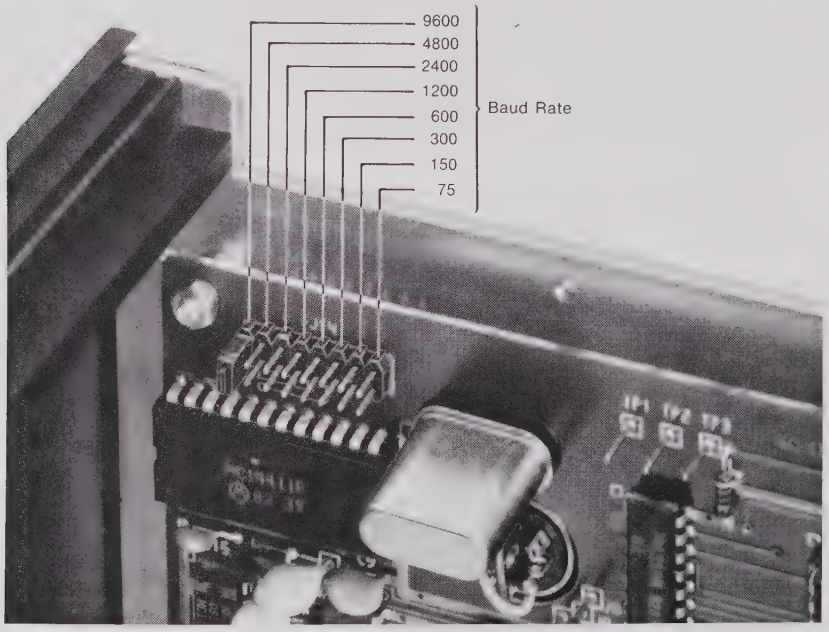

Fig. 7.1. Location of jumper plug for changing the baud rate

7.1.2. Personal Text

Prior to typing in the text, one of the textlines has to be selected, then the characters can be typed in directly. Table 7.1 gives a list of the relevant pushkey commands.

Terminal	Result
G_c 0	select textline 0
G_c 1	Select textline 1
G_c 2	Select textline 2
G_c 3	Select textline 3
G_c 4	Select textline 4
G_c C	Clear selected textline and return to first character position
G_c T	Remote control of 2313 front panel, see Table 7.3
Another ASCII Control Character	A special character is put in the current position of the selected textline then incremented to the next character position, see Table 7.2
G_c 〈other ASCII character〉	Return to first character position in the selected textline
ASCII Character	The character is put in the current position of the selected textline then incremented to the next character position

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Table 7.1. Remote terminal pushbutton commands, where suffix c denotes a control character

In addition to the standard ISO characters, special characters can be entered from a list of control characters according to Table 7.2, e.g., N_c (Control N, equivalent to ISO control character SO) would give a ±.

Terminal	ISO	2313 Char.	Terminal	ISO	2313 Char.
$@_c$	NUL	Δ	P_c	DLE	π
A_c	SOH	α	Q_c	DC1	∫
B_c	STX	²	R_c	DC2	æ
C_c	ETX	Σ	S_c	DC3	σ
D_c	EOT	δ	T_c	DC4	τ
E_c	ENQ	ε	U_c	NAK	ü
F_c	ACK	φ	V_c	SYN	√
H_c	BS	Ω	W_c	ETB	–
I_c	HT	⁰	X_c	CAN	↑
J_c	LF	⁰	Y_c	EM	↓
K_c	VT	Ø	Z_c	SUB	→
L_c	FF	λ	$[_c$	ESC	←
M_c	CR	μ	$\backslash_c$	FS	¯
N_c	SO	±	$]_c$	GS	_
O_c	SI	■	$\hat{}_c$	RS	|
			$-_c$	US	|

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Table 7.2. Table of remote terminal commands for writing special characters in the textline, where suffix c denotes a control character

7.1.3. Remote Control of the 2313 Front Panel

It is possible to remotely activate the front panel pushkeys via the terminal. To set the terminal for remote operation, key in G_c (Control G, equivalent to ISO control character BEL) followed by 'T', thereafter the 2313 will be controlled by the terminal according to Table 7.3. Remote control will cease on pressing the letter 'O' on the terminal.

Terminal	2313 Front Panel	Terminal	2313 Front Panel
0	0	Y	Yes
1	1	E	E
2	2	N	No
3	3	/	/
4	4	W	Extension
5	5	C	Clear Entry
6	6	P	Page
7	7	H	Help
8	8	S	Setup
9	9	RETURN	Execute
–	–		
.	.	O	(cease remote control of 2313)

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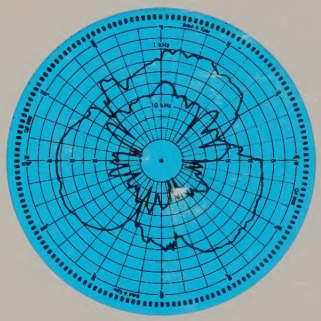
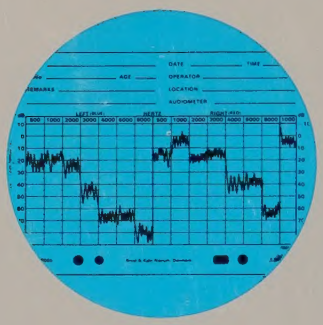
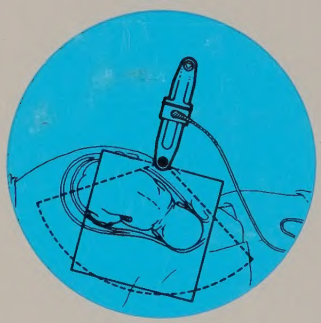
Table 7.3. Table of remote terminal commands for activating the 2313 front panel pushbuttons

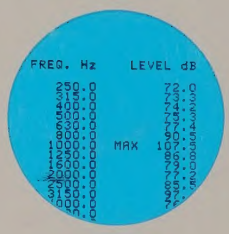
8. SERVICE AND REPAIR

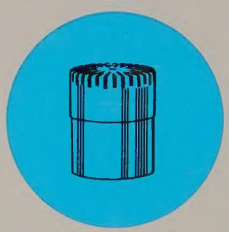
The 2313 is designed and constructed to provide the user with many years of safe, reliable operation. However, should a fault occur which impairs its correct function and possibly operating safety, then it should be immediately disconnected at the mains source and be secured against unintended operation. For repair consult the separate Service Instruction Manual for the instrument or contact your local B & K service representative. Under no circumstances should repair be attempted by persons not qualified in the service of electronic instrumentation.

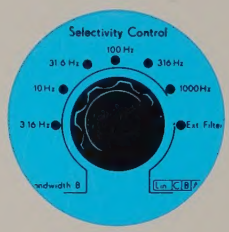


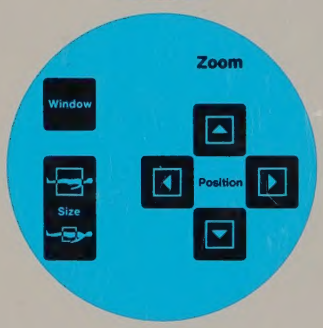


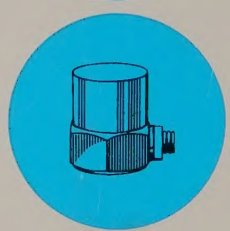


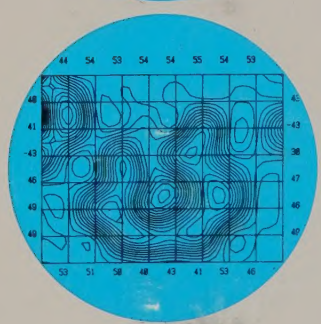












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